ISMST

International Society for Medical Shockwave Treatment

12th International Congress of the ISMST

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Abstracts

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1. Imaging Bubbles in Vessels

Tom Matula, H. Chen, A. Brayman

Institutions:
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1013 NE 40th St., Seattle, WA 98105, USA

Device and producing company: ---

Introduction: Cavitation is a possible mechanism for generating beneficial bioeffects in shock wave therapy. But how do the bubbles interact with tissue and blood vessels? We have been able to study the instantaneous direct interaction between a bubble and a blood vessel. The interaction shows that blood vessels dilate with bubble expansion and invaginate with bubble collapse.

Methods: Stabilized microbubbles are injected into a rat superior mesenteric artery. The ex-vivo mesenteric tissue is then placed under a high-powered microscope. A region is insonified with ultrasound and imaged with a high-speed camera. The bubble growth, collapse and corresponding vessel motion is analyzed.

Results: The growth of bubbles is highly constrained compared to what occurs in the absence of tissue. In many cases, vessel wall invagination is much greater than dilation. The maximum velocity of the vessel wall during invagination can be tens of m/s.

Discussion: When a bubble expands, a large area of the vessel wall dilates. When the bubble collapses however, we often see a very localized invagination, even "jetting" of the tissue into the blood vessel. We hypothesize that this localized invagination is associated with micro-capillary damage. It is possible to consider the blood and surrounding tissue as two different "fluids" with an elastic, breakable membrane that separates these two fluids.

Conclusion: Using high speed photography, we have observed the coupled interaction of an oscillating bubble with a vessel wall. The interaction shows vessel wall dilation, invagination, and even rupture when the pressure amplitude is high. (Support provided by NIH 1R01AR053652 and 5R01EB000350).

2. Total Energy Emitted: Is this the Most Important Factor for the Efficacy of ESWT?

Maria Cristina Ottone (1), F. Fagnani (2)

Institutions:
1) ASL Al - Distretto di Tortona, Via Milazzo 1, Tortona, Italy;
2) Alliance Medical Group - via Alunno, 23 - Milano, Italy

Device and producing company: Piezoson 300, WOLF

Introduction: We want to verify the importance of total energy delivered by comparing the results of using a large focus with low energy density and a small focus with high energy density.

Methods: The treatment was performed using a Piezoson 300 from WOLF, a focused piezoelectric generator with three different focal dimensions. This study includes:
Group A: large focus and low energy density (0.06 mJ/mm^2)
Group B: small focus and high energy density (0.18 mJ/mm^2)
Each patient received 4 applications, 2000 shock waves/session.

Results: The follow-up is ongoing and we will present the results during the meeting.

Discussion: Last year we presented the preliminary results of a study in which we compared different protocols varying the focus dimension and energy density with a stable value of total energy (mJ) emitted. The evaluation of final data confirmed a strong link between the efficacy of ESWT and the total energy emitted, however we stated that a future study which included more patients was warranted. Hence we continue this work to verify the results of treatment using a new and larger sample of patients.
Conclusion: Preliminary results seem to confirm the strong dependency between efficacy of ESWT and the total energy emitted. We are currently evaluating the patients in order to obtain final data to draw final conclusions that will be presented at the Congress.

3. Extracorporeal Pulse Activation Therapy (EPAT): Efficacy of Pressure Pulse Transmitters

Pavel Novak

Institution:
Storz Medical AG, Lohstampfestr. 8, 8274 Tägerwilen, Switzerland
Device and producing company: Duolith SD1, Storz Medical AG
Introduction: Extracorporeal Pulse Activation Therapy (EPAT) uses the therapeutic effect of radial pressure pulses or waves respectively generated by differently shaped transmitters. These transmitters are used selectively for different indications.
Methods: The energy emitted by different types of transmitters (DeepImpact, D-Actor, V-Actor, etc.) and its distribution within the body were measured by various methods (laser interferometer, pressure and force transducer) then analyzed. The two typical pressure pulses, released when the projectile accelerated by compressed air hits the transmitter, lie within two frequency bandwidths: 100Hz-10kHz and 80kHz-200kHz. The slower pressure pulse cannot be measured by pressure transducer within a laboratory setting using water as a tissue phantom. A more solid, visco-elastic material is needed. By comparison, the faster pressure pulse can be measured more easily by conventional methods used for shock waves.
Results: The measurements show that the different penetration depths and radiation fields are dependent on transmitter shape, material and type of attachment within the hand piece.
Discussion: With regard to pressure pulse generation, it is typical to use the driving pressure for quantifying the energy level applied. A physical parameter describing the energy delivered to the tissue would be beneficial. Still, when considering both pulse types, the energy flux density might easily exceed the typical values used with shock waves and thus be considered confusing.
Conclusion: Further scientific evaluation of the relationship between pressure pulse properties and their physiological effects within the tissue is necessary for a better understanding of the biological-physical interactions and for determining possible methods to extend and improve the treatment procedures.

4. A Neural Model for Chronic Pain and Pain Relief by Extracorporeal Shock Wave Treatment

Othmar Wess

Institution:
Storz Medical AG, Taegerwilen, Switzerland

Device and producing company: Shock wave devices in general e.g. DUOLITH SD1, Storz Medical
Introduction: Shock waves are used for urinary stone treatment and for several chronic pain diseases. The etiology of those diseases is mostly unknown but hypothesized to be based on neurobiology. There are numerous chronic pain syndromes in orthopaedics/rheumatology or cardiology, successfully treated by extracorporeal shock wave treatment (ESWT). The working mechanism of ESWT is not completely known.
Methods: Chronic pain without underlying anatomical disorder is looked at as a pathological control function of memory or "pathological conditioned reflex". Reflexes are considered engraved memory traces linking sensory input with motor response. This feature can be described by associative memory functions of the nervous system. Some conditioned reflexes may cause inappropriate or "pathological reactions". Consequently, a circulus vitiosus of pain sensation and muscle and/or vessel contraction is generated when pain becomes chronic (pain spiral).
Results: A neural theory of chronic pain is developed on the basis of a neuro-holographic brain model. It explains how ESWT may delete pathologic memory traces by mechano-sensory-transduction and hyperstimulation, resulting in permanent pain relief.
Discussion: The neuro-holographic brain model may be one among others to shine a light on the neural mechanism of chronic pain and, simultaneously, may lead the way to developing appropriate therapies.
Conclusion: In a generalized manner, the concept of associative memory functions may help to understand conditioning as a learning process and explain ESWT as an efficient method for treatment of chronic pain. This concept may open the door for new treatment approaches to chronic pain and other disorders of the nervous system.

5. ESWT Guidelines

Richard Thiele, M. Gleitz, M. Maier, M. Buch, G. Wille, H. Neuland, W. Schaden, J.-D. Rompe, R. Rädel, V. Auersperg, L. Gerdesmeyer

Institution:
DIGEST Kurfuerstendamm 61, 10707 Berlin, Germany
Device and producing company: n. a.
Introduction: Since 1994 ESWT has been applied in the fields of orthopaedics and general surgery but there were no concrete treatment guidelines. Therefore a board of international experts modified the guidelines for the standard indications.
Methods: According to the consensus statement of the international board of experts from 2008 (published in the ISMST Newsletter and on the homepage of DIGEST) the experts established guidelines which the AWMF (working group of scientific approved societies in Germany) currently uses.
Results: These guidelines will be presented for ESW treatment of chronic tendinopathies and treatment of the skeletal muscles. New guidelines were developed for chronic tendinopathies such as tennis elbow, plantar fasciitis with or without heel spur, calcifying tendinopathy of the shoulder, patellar tendinopathy, Achilles tendinopathy, greater trochanteric pain syndrome, impaired bone healing (non-unions, stress fractures, AFN, OD of knee and talus) and the newly-defined field of ESWT for skeletal muscles.
Discussion: Is it possible to work out such concrete guidelines for all indications and for all devices which are used worldwide?

Conclusion: Guidelines should be published from the societies for all scientific studies, treatment standards, reimbursement and training and certification of doctors worldwide should be validated.

6. Focused and Radial Shock Wave Treatment Influence Human Mesenchymal Stem Cells

Helmut G. Neuland, Y. Delhasse, C. Steiningen, A. Schmidt, W. Bloch

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Sports University Cologne, Institute for Cell and Molecular Biology, Germany
Device and producing company: Piezoson 100, Wolf Company, Germany
and Swiss Dolorclast, EMS, Switzerland
Introduction: Focused and radial shock waves can influence mesenchymal stem cells. Therefore it can be speculated that shock waves can influence tissue repair and regeneration in this way.
Methods: By special experimental studies we can demonstrate that migration, cytoskeleton, proliferation and apoptosis of MSC`s can be influenced.
Results: The present results show that MSC`s dose and frequently dependently influenced by different kind of shock waves.
Discussion: The question was whether the radial or the focused shock wave application had different effects on MSC`s.
Conclusion: The dose range for a pro-migration effect seems small for focused compared to radial shock waves. A pro-proliferation effect is only seen for focused shock waves.

7. SW on Human Platelet-Rich Plasma (PRP) and Osteoblasts

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Institutions :
) Department of Clinical Methodology and Surgical Techniques, Orthopedics Section
2) Department of Human Anatomy and Histology
3) Blood Transfusion Service, University of Bari, Italy
Device and producing company: Minilth SL1, Storz
Introduction: ESWT involves mechanical disturbances that can result in mechanical stimulus to a large number of cell lines. The aim of this study was to assess the interaction of different cell populations, osteoblasts and platelets, after the stimulation of only one of them.
Methods: Human platelet-rich plasma (PRP) was exposed to a single ESW treatment (0.16 mJ/mm^2, 500 impulses) then added to mouse calvaria osteoblast (OB) cultures. Cell activity was evaluated by Western-blot and real time-PCR experiments.
Results: We found an increase of Growth Factors involved in OB proliferation and differentiation. In addition, the increase of the markers of osteoblast maturation (RUNX2, Collagen I and Osteocalcin) was demonstrated. Our findings suggest that the recruitment of platelets is a critical step in the bone reparation process and is enhanced by ESW treatment.

In fact, Insulin Growth Factor-1 and IGF-Binding Protein-3 are proposed to play a chemo tactic and mitogenic role in differentiation and proliferation of OB. Shock waves can produce activation of platelets, and drive OB to express genes for osteogenesis.
Discussion: Previous studies showed SW positively influence OB proliferation modulating membrane permeability and intracellular signalling. In this study, we found that these effects can also be achieved by the stimulation of other cells. Therefore, it is probable that during applications in vivo the stimulation of shockwaves could be the sum of the interaction of different cell lines.
Conclusion: In recent years the application of PRP has emerged as a potential solution in bone and tendon injuries. The present results demonstrate that PRP could be added to SW to increase the osteoblastic activity.

8. Wound Healing - Influence of focused and radial shock wave treatment on the behaviour of human mesenchymal stem cells

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2) ZES, Centre for ESWT, Kronberg im Taunus, Germany

Device and producing company: Swiss DolorClast (EMS), Piezoson 100 (Richard Wolf)
Introduction: Recent studies demonstrate the successful use of shock wave therapies for improvement of wound healing disorders. Mesenchymal stem cells seem to be involved in tissue regeneration such as occur in wound healing. Therefore the question arises as to whether shock waves can influence mechanisms involved in stem cell dependent regeneration. MSC dependent regeneration can be improved by inducement migration, proliferation and apoptosis. Migration is of particular importance with regard to MSC's reaching the target location.
Due to the fact that two different kinds of shock waves (focused and radial) improve mesenchymal stem cell dependent regenerative processes such as wound healing, it seems appropriate to investigate the influence of both kinds of shock waves on MSC's.
Methods: We established a new experimental cell culture setup for shock wave treatment under more absorbing conditions to better simulate in vivo circumstances. We tested the effects of different intensities of energy, frequency and total number of shocks on MSC's to investigate changes in cytoskeleton ((F-Actin) by phalloidin staining) and migration (by Boyden chamber assay) for both kinds of shock waves.
Results: We developed methods for in vitro treatments of MSC's with both kinds of shock waves that guarantee cell vitality and allow investigation of both kinds of shock wave treatments. We can show significant results in influence of migration and reorganisation of cytoskeleton (F-Actin) dose dependency with both kinds of shock wave treatments. Different shock wave systems show a different range of efficiency in our investigations. Treatments with densities of energy of 0.077 mJ/mm² with a focused shock wave system show significant increase in the migration and reorganisation of F-Actin fibers without actin accumulation. We detected converse results at treatments with higher energy levels of 0.122 mJ/mm² in migration and reorganisation of cytoskeleton. Small spots of actin accumulation were visible at higher doses of 0.122 mJ/mm². Treatments with 0.122 mJ/mm² had a lower rate of migration in Boyden Chamber Assay but a higher rate of reorganisation of cytoskeleton

compared to control. Radial shock wave treatment shows a significant increase in migration by densities of energy of 0.50 bar but no significant increase effects of the reorganisation of cytoskeleton.
Discussion: The present results indicate that MSC's can be influenced depending on the dose of shock wave treatments. We can verify explicit influences on migration of MSC's with both kind of shock waves, but with different ranges of efficacy. The results also provide evidence for a distinct dose-dependent influence of shock waves for cytoskeletal organisation with signs of cytoskeletal disruption at higher doses leading to an inverse migratory effect.
Conclusion: We can show the importance of correct dosing for treatment especially for focused shock waves.

9. The Effect of Shock Waves on Differentiation and Function of Myofibroblast

Enrico Vigato (1), G. Pietramaggiori (1), B. Hinz (2), B. Pittet (2), F. Bassetto (3)

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2) Ecole Polytechnique Fédérale de Lausanne (EPFL), 1015 Lausanne, Switzerland.
3) University of Padova, Padova, Italy
Device and producing company: DermaPACE (Sanuwave)
Introduction: It is widely known that mechanical forces can influence cell proliferation; recent findings show that closure of chronic non-healing wounds in humans can be accomplished using devices that exert mechanical stresses on healing tissue. Extracorporeal shock wave therapy (ESWT) has been applied in lithotripsy and in the treatment of several musculoskeletal disorders over the past decade, but its effects on non-healing wounds remain unclear.
Methods: We investigated in vitro how shockwaves influence the development and function of myofibroblasts, the cells that promote contraction during wound closure. Human dermal fibroblasts were subjected to 250, 500, and 1,000 shock wave impulses at different energy densities on day 1, 4, and 7. The expression of α-SMA (the hallmark of myofibroblast differentiation), TGF-b and TGF-b RII was assessed through immunofluorescence microscopy and western blots. The contractile function of fibroblasts was measured as a function of their ability to generate wrinkles on deformable substrates. The ability to contract extracellular matrix was quantified in 3D collagen gels.
Results: The preliminary results show an increased proliferation rate among fibroblasts subjected to shock waves compared with controls; the myofibroblast differentiation is influenced by shock wave therapy as well.
Discussion: The use of non-pharmacological inductors of cell proliferation such as shock waves is an intriguing possibility to accelerate and control wound healing
Conclusion: These preliminary results, if confirmed, could support the use of ESWT to assist closure in various non-healing wounds.

10. Significance of Analgesia Induced Focused Shock Waves in Proximal Plantar Fasciitis

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Device and producing company: Endomedica/Medispec-Orthospec®
Introduction: Proximal plantar fasciitis is defined as a clinical entity characterized by pain and inflammation of the plantar fascia at the subcalcaneal area of the foot. Aines, physiotherapy, orthosis, shock waves and surgery have demonstrated produced highly variable results.
Methods: An experimental study was performed from November 2001 to February 2007 which included 367 patients (465 feet) with proximal plantar fasciitis. The patients received focused shock waves with electro hydraulic equipment (ORTHOSPEC®); intensity: 0.16 mJ/mm2, frequency: 196 waves/minute, in a single session. Clinical and ultrasound evaluation was performed, visual analogue scale (V.A.S.) and satisfaction level measured. Beginning of Analgesia to collect question`s patient. Subsequent follow-up was performed every six weeks after treatment, with a minimum of 10 months and a maximum of 6 years. Descriptive and inferential statistical analysis was used with a difference between averages and technique of Squared Chi, significance level of 0.05.
Results: The patients were predominantly female, mean age 53 years; beginning of analgesia 820 waves, deviation of 400 waves, total waves/session 1,620, standard deviation 730 waves. The difference between Initial and Final EAV and EAV/Level of satisfaction was significant at the level of 0.05 p=0.0001; good - 323 (69.5%),
fair - 80 (17.2%), poor - 62 (13.3%).
Discussion: There was a low correlation (0.02) between number of waves necessary for beginning of analgesia and time of evolution. There also was a clear dependency between level of satisfaction and number of waves at the beginning of analgesia.
Conclusion: Application of a lower number of waves for the beginning of analgesia can play an important role in explaining the best evolution in plantar fasciopathies.

11. ESWT Versus ESWT Combined with Infrared Low Level Laser Therapy (LLLT) in Treatment of Chronic Plantar Fasciitis

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3) World Federation of Societies for Laser Medicine and Surgery, Tokyo
Device and producing company: BTL5000 SWT Power, BTL5000 Laser
Introduction: Chronic Plantar Fasciitis (CPF) is one of the most common causes of heel pain. It was previously proven that ESWT is an effective conservative treatment for CPF, with better outcomes produced with higher energy ESWT however, the heel pain frequently recurs. Therefore the possibility of using other forms of conservative therapy as an adjunct to ESWT rather than performing surgery should be considered, as the indications for surgery are not well codified. The studies considering efficacy of GaAlAs low level laser therapy (LLLT) brought conflicting results, thus LLLT in monotherapy of plantar fasciitis remains

controversial. The aim of this prospective study was to evaluate the effectiveness of ESWT in monotherapy as well as the effectiveness of ESWT followed by application of LLLT.
Methods: We studied 96 patients (96 heels) with chronic plantar fasciitis persisting for at least 6 months. Fifty patients were included in the ESWT only group (group A) and 46 patients in the ESWT/LLLT group (group B). Initial evaluation included completing visual analogue scale (VAS), short form of McGill questionnaire and Roles and Maudsley scale. The VAS as evaluated before each application. Follow up was done 2 weeks and 2, 4, 6 and 12 months after the last application. In the ESWT only group, 2000 shockwaves in 4 weekly sessions were delivered by BTL5000 Power SWT device. Applied energy was 0.16 mJ/mm^2 at a frequency of 8 Hz. In the ESWT/LLLT group, the same shockwave therapy procedure was provided and immediately followed by application of GaAlAs infrared laser, wavelength 830 nm, continuous frequency, output power of the probe was 400 mW with total dose per session equal to 20 J/cm^2.
Results: The complete data from 89 patients were collected. Seven subjects (4 in the group A and 3 in the group B) did not complete the study for various reasons. There was no difference in baseline pain and basic demographic data between groups A and B. VAS improvement in ESWT and ESWT/LLLT groups at 2, 6 and 12 months follow-up was significant in both groups.
Discussion: Both ESWT and ESWT/LLLT applications are safe and effective in treatment of chronic plantar fasciitis. From the long-term perspective, the efficacy is comparable in both groups. LLLT seems to be more beneficial at the beginning of the therapy.
Conclusion: Combining ESWT with GaAlAs low level laser therapy appears to provide moderate improvement in the initial phase of treatment. Further investigation is necessary to validate these results.

12. rESWT in cases of “particular” plantar fasciitis

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Device and producing company: MASTERPULS 200, Storz Medical
Introduction: ESWT is proven as an efficient method for treatment of plantar fasciitis. The mean overall in all presented studies is up to 60% with no residual complaints and significantly better in up to 30% with 6 months follow-up.
The following study presents experience in application of rESWT in some particular cases of plantar fasciitis, such as after a few childhood operations for talipes quinovarus (2 patients), patients with painful plantar scars after plantar lacerations (3 patients) and relapse after surgery with plantar fasciitis nodosa (2 patients).
Methods: The treatment was performed with the Storz Masterpuls 200 device, R15 applicator, 5 procedures at weekly intervals, 6000 impulses at 2 bars and 15Hz over the painful area and another 2000 impulses with the same power over the entire plantar surface.
Results: We assessed the results following pain by Visual Analogue Scale (VAS) before each procedure and after three and six months. Our study presents the final results as follows: no pain (VAS≤20) in 5 patients (71%) and substantially improved (VAS ≤ 30) in 1 patient (14%).
Discussion: The above mentioned results are similar to those officially presented by all other authors especially with regard to treatment of typical plantar fasciitis.

Conclusion: The high success, absence of any risks, and full patient satisfaction presented in our study, make rESWT the method of choice not only in typical plantar fasciitis cases but also in a few other particular cases regarding plantar fascia disturbances.

13. Comparison between the efficacies of three dosing regimens of extracorporeal shock wave therapy for the treatment of chronic plantar fasciitis

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Device and producing company: Dornier Epos Ultra
Introduction: The optimal dosing regimen of extracorporeal shockwave therapy for the treatment of chronic plantar fasciitis remains to be determined. A review of the published literature reveals a wide variation in the dosing regimen, with variation in the number of pulses administered in each session, total energy administered, energy flux density of the shockwaves, time interval between treatment sessions, and number of treatment sessions administered.
Methods: The aim of this study is to compare the effect on pain reduction between three dosing regimens of extracorporeal shock wave therapy (ESWT) in the treatment of chronic plantar fasciitis through a randomized comparative non-blinded trial comparing efficacy in pain reduction and reduction in plantar fascia swelling. The first treatment arm consisted of two sessions of 2000 shocks administered 1 week apart, the second treatment arm consisted of two sessions of 2000 shocks administered with a one-month interval and the third treatment arm consisted of the equivalent number of shocks administered in a single session. A total of 90 patients were recruited for the study with 30 patients randomly assigned to each treatment arm. Follow ups were arranged at one month and three months post treatment.
Results: Reduction in pain and plantar fascia swelling for the first and second treatment arms were not significantly different at the first and second follow up. By comparison, there was significant reduction in pain score and swelling of the plantar fascia in the third treatment arm compared to the first.
Discussion: Although the subjects were not blinded to the treatment arm, care was taken not to imply superiority of any of the treatment arms, in order to reduce bias.
Conclusion: The clinical efficacy of ESWT treatment for plantar fasciitis in a single session is superior to multiple sessions.

14. Plantar fasciitis treatment: physical therapy with US versus ESWT

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Device and producing company: Ossatron device, HMT s.r.l
Introduction: Extracorporeal Shock Wave Therapy (ESWT) was approved by the Food and Drug Administration (FDA) specifically for treatment of Plantar Fasciitis (PF) in 2001. In order to investigate the role of ESWT concerning the clinical evidence of efficacy, we performed a comparative study of ESWT versus other therapies, particularly Ultra Sound (US) physical therapy.

Methods: We have recently performed a systematic review of our clinical cases, evaluated over a three-year period in our ESWT out-patient clinic. We checked three patient groups treated, respectively, with ESWT only (group 1), US only (group 2) and ESWT after US with poor clinical results (group 3). We performed a comparison between the two therapies and an open study with a control group.
Results: Significant clinical improvement was obtained by both groups (group 1 and 2). We noted no statistical significance in the results of ESWT versus US. Good clinical and functional results of ESWT after US therapy were registered in the analysis of the control group.
Discussion: The result of the comparison of Group 1 versus Group 2 could be due to the different clinical conditions of the two groups. In the control group however, we performed a case control analysis and we avoided selection bias.
Conclusion: ESWT appears to reduce plantar fasciitis in patients who were previously treated with other physical therapies without clinical improvement. Even so there is not sufficient data to prescribe ESWT as first choice treatment.

15. Effectiveness of Shock Wave Therapy in Patients with Chronic Plantar Fasciitis

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2) Cortrel, Rio de Janeiro, Brazil
3) Orthomaster, Sao Paulo, Brazil

Device and producing company: Reflectron, HMT
Introduction: Three Brazilian centres for shockwave therapy participated in a retrospective study to evaluate the effectiveness and safety of shockwave treatment in patients with chronic plantar fasciitis.
Methods: The effects of the shock wave therapy were investigated in 285 patients (297 plantar fascias) over an 80-month period, from March 2001 to November 2007.
Twelve patients received bilateral treatment. One hundred and fifty-four (154) women and 131 men were treated. The ages ranged from 25 to 90 years with average age of 54 years. Each patient was treated after receiving medial and lateral regional nerve block anaesthesia (posterior tibial and peroneal nerve) and, in some cases local anaesthesia, with 1200-1500 pulses of shockwaves at 20 mm of depth focus and 0.14 mJ/mm^2 of energy flux density. The results were analyzed 45, 90 and 180 days after the final treatment. The subjective analysis of pain was accomplished by visual analogical scale and clinical evaluation was performed in accordance with Roles and Maudsley Score.
Results: One hundred and eighty (180) days after treatment the results were classified as: excellent in 50.2%; good in 26.6%; acceptable in 8.1% and poor in 15.1% of the patients. We did not observe any case of worsening of the initial complaints. No cases were recommended for surgery.
Discussion: Extracorporeal shock wave therapy produces significant relief of pain and decreases physical incapacity produced by chronic plantar fasciitis.
Conclusion: Shock wave therapy is a new safe treatment modality to treat patients with chronic plantar fasciitis that failed conservative treatment.

16. Plantar fasciitis: Follow up four years after ESWT

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Device and producing company: Minilith SL1, Storz Medical
Introduction: Plantar fasciitis is the most frequent cause of tallodinia in adults (1). It is linked to obesity and to calcaneal spur (2-3) and is characterized by severe pain with functional impotence more pronounced on awakening (4).
Methods: Twenty-five (25) patients (14 M and 11 F) mean age of 60, 15 years were followed at our clinic for plantar fasciitis and functional impotence in the morning. All patients had severe tallodinia for at least 6 months with no response at analgesic treatments. The patients were assessed by the Ankle-Hind Foot scale (AOAFS) at the beginning and the end of treatment; this evaluation was repeated at the 3-month, 2-year and 4-year follow up examinations. Twenty-one (21) patients completed the study. Exclusion criteria was: patients who had undergone surgery on the plantar fascia; previous fracture of the foot; ankle trauma or severe contusion and distraction, patients with rheumatoid arthritis; ankylosing spondylitis; Reiter's syndrome; severe osteoarthritis of the hip or knee; and diabetes. Processing consisted of shock wave treatment (ESWT) once a week for 4 sessions total. Each session consisted of 2,400 pulses at 0.04 mJ/mm^2 with the Minilith SL1 by Storz Medical. The statistical difference was conducted with the Wilcoxon test for paired samples. Minimum level of significance is $p = 0.05$.
Results: We found a clear reduction of pain and increase in functional improvement at different times during the study with results that are maintained at 2 and 4 years after treatment ($p<0.001$).
Conclusion: Our results seem to underline the usefulness of the treatment of plantar fasciitis with ESWT. The reduction of pain, the recovery of adequate support of the foot and _____ walking suggest that ESWT is the most effective therapy for this disease, with good results even after 4 years.
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17. ESWT in the Treatment of Plantar Fasciitis: follow-up at three years

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2) No institution
Device and producing company: Piezoson 300, WOLF

Introduction: The efficacy of ESWT in orthopaedic disorders has been confirmed in many studies, including double blinded. The basic research studies have demonstrated that the application of ESWT produces a biological response in tissues. In this study we want to verify the efficacy and the safety of ESWT in the treatment of plantar fasciitis after three years.
Methods: Three years ago we treated 70 patients with plantar fasciitis. We checked them six months and three years after the treatment. The treatment was carried out using a WOLF Piezoson 300, a focused piezoelectric generator. Each patient received 4 applications, 2000 shocks/session, energy density 0.20 mJ/mm^2.
Results: At three years follow up we have the same positive results we had in the short term and the degree of satisfaction of the patients was reported as excellent or good in 76%.
Discussion: The results of conservative treatment in plantar fasciitis are often poor and of short duration: in this study we demonstrate the longer lasting efficacy of ESWT in the treatment of this pathology that can be severe not only in terms of the prognosis but also for the quality of life.
Conclusion: The efficacy and the safety of ESWT in the treatment of plantar fasciitis and also its prolonged effectiveness make this therapy an alternative method of treatment for this pathology.

18. The Effectiveness of Extracorporeal Radial Shock Wave Therapy for Patients with Plantar Fasciitis

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Device and producing company: Swiss Dolorclast, EMS Medical
Introduction: Plantar fasciitis is a common cause of heel pain, affecting 10% of the general population. Extracorporeal shock wave therapy (ESWT) has been recommended as treatment for chronic plantar fasciitis in patients unresponsive to conservative treatment. The primary goal of this study was to determine the effectiveness of extracorporeal shock wave therapy compared with placebo in the treatment of chronic plantar fasciitis.
Methods: A prospective, randomized, blinded, controlled study with two groups of subjects each was proposed. The study involved 104 patients (104 heels), including 52 patients (52 heels) in the shockwave treatment group and 52 patients (52 heels) in the control group. All patients had been suffering from plantar fasciitis for at least 6 months. Pre-treatment measurements included a visual analog pain scale (VAS) and the modified Roles and Maudsley scale (R&M). In the shock wave group, therapy was applied once a week for two weeks (2 x 2000 impulses) at an air pressure of 3.5 bars and frequency of 8 Hz at each session. The patients in the placebo group received treatment with the clasp on the heel. ESWT was performed without local anaesthesia. At the fourth week the subjects again completed a VAS and R&M.
Results: At 4 weeks, there was a mean VAS decrease of 6.56 (79.7%) for the experimental group; there was a mean decrease of 2.94 (32.5%) for the control group. There was a statistically significant ANOVA group by time interaction indicating the experimental group had a greater decrease in pain when compared to the control group p and an increase in quality of life when compared with the control group p.
Discussion: Extracorporeal shock wave therapy has a statistically significant decrease in pain scores than placebo for patients with plantar fasciitis. Extracorporeal shock wave therapy has

a statistically significant increase in functional outcome (better quality of life) than placebo on patients with plantar fasciitis.
Conclusion: Shock wave therapy is effective and safe for the treatment of chronic plantar fasciitis.

19. Evidence-Based Analysis of Level I Studies Involving f-ESW or r-ESW for Plantar Fasciopathy

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Introduction: The utilization of extracorporeal shock wave treatments for plantar fasciopathy (fasciitis) has progressively increased since the Food and Drug Administration approval of the initial device (OssaTron) in 2000. Since then at least five additional devices have been approved. All approvals required variably randomized studies, many (but not all) of which have been published in peer reviewed journals. The number of randomized, variably blinded prospective studies (Level I) also has increased. However, the effectiveness of this treatment modality continues to be questioned, especially by the US private health insurers. We chose to expand our previous meta-analysis (Toronto, 2007) to conduct a systematic analysis and update of Level I studies.
Method: We searched several electronic databases (MEDLINE, EMBASE, CINAHL, COCHRAN) and other relevant resources for the use of ESW in plantar fasciopathy (fasciitis), in any language, from 2000 to 2008. In addition, we searched by hand relevant journals published in that same time period, as well as bibliographies of reviews concentrating on musculoskeletal applications of ESW. Information on the methodological quality, stimulation device, pattern of treatment, patient demographics and clinical outcome was extracted from those studies determined to be Level I. The appropriate Level I studies then were combined to systematically assess whether extracorporeal shock waves were clinically beneficial to patients with refractory plantar fasciopathy.
Results: Seventy-seven (77) clinical studies specifically assessed ESW for treatment of plantar fasciopathy. However, only seventeen (17) fit the accepted criteria for a Level I study. A multiple question checklist was used to assess each study individually. Fifteen studies supported the statistically valid effectiveness of ESW for plantar fasciopathy. One study had equivocal results. Only one study found negative results. All studies reported decreased or complete relief of pain (usually in at least three parameters) in successfully treated patients. Some pain relief occurred even in unsuccessful patients, but not enough to fulfill success/failure criteria.
Conclusions: Our pooled analysis of Level I studies showed a significant impact supporting the use of ESW for plantar fasciopathy in patients who have failed multiple antecedent conservative treatments. However, there are methodological limitations that prevent specific device comparisons.

20. Shock wave therapy in tennis elbow: long term follow-up, pitfalls and complications

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Device and producing company: Dornier Epos Ultra

Introduction: A prospective study was performed between July 2004 and July 2008, which included patients of both sexes and at least 6 months follow-up after therapy.

Methods: Fifty-one patients were treated in this study (22 male and 29 female), in 49 patients the dominant hand was affected and in 2 the non-dominant hand. Initially 26 patients reported severe pain, 22 moderate and 4 mild. After 3 to 5 treatment sessions with focused shock waves at level 7 (3200 pulses), 6 patients had severe pain and 32 mild pain or burning sensation. Thirty-eight patients returned to normal activities within 30 days.

Conclusion: In conclusion, focused shock waves are a successful and reproducible method for the treatment of tennis elbow. Burning sensation, epidermolysis and decrease in muscular-grip force were the most severe complications. Three cases did not respond due to false diagnosis: osteochondritis, radiocubital synovitis and entrapment of the radial nerve in Froshe's arcade.

21. Focused and Radial Extracorporeal Shock Wave Therapy for Lateral Epicondylitis: Preliminary results

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Device and producing company: Duolith SD 1, Storz Medical

Introduction: Extracorporeal shock wave therapy (ESWT) has been used in the treatment of lateral epicondylitis for several years. The results from previous studies have been conflicting. The aim of this study was to evaluate the effectiveness of focused and radial extracorporeal shock wave therapy (ESWT) for the treatment of lateral epicondylitis.

Methods: Twenty recreational athletes aged between 20 and 30 years (mean age: 25.2±3.1 years) with unilateral lateral epicondylitis participated in this study. All participants underwent clinical and instrumental diagnosis (X-rays and ultrasonography). They had been previously treated with physical therapy, local injections and other conservative procedures for at least 6 months. Focused and Radial ESWT were assigned to 3 treatments, 1 per week for 3 weeks. In each session, 1000 pulses of 0.1 to 0.15 mJ/mm^2 and 3000 pulses of 1.4 to 2.2 bar depending on the participant's pain tolerance, were administered respectively. Overall elbow pain using the visual analogue scale (VAS) and maximum pain-free grip strength (MPFGS) were used to evaluate each subject before the treatment and 4 weeks after the treatment. Isokinetic peak torque of the wrist flexor and extensor muscles were assessed eccentrically and concentrically at test speeds of 1200/s in pre and post treatment sessions.

Results: Before treatment, concentric and eccentric extensor strength were found to be significantly lower in the lateral epicondylitis wrist compared to the healthy control.

Conclusion: ESWT appeared to be an effective treatment for chronic lateral epicondylitis.

22. Chronic Golfer's Elbow: How can we obtain good results with ESWT?

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Device and producing company: Dornier Epos Ultra
Introduction: Chronic medial epicondylitis is a painful and disabling condition that is very difficult to treat satisfactorily with any therapy, even with ESWT, as verified in the published literature.
Methods: Since 1998, I have treated more than one thousand cases of chronic epicondylitis, of which 104 were medial epicondylitis. Various modifications to my initial treatment protocol were required to obtain good results. High energy, analgesia and the method of application are the key factors.
Results: Over the last 3 years I have treated 48 cases of chronic epitrocleosis. The mean number of treatment sessions is 4.8. The results were: Excellent and Good - 42 (87%), Fair - 2 (4%) and Poor - 4 (8%).
Discussion: Proper focalization of the energy, proper amount of energy and proper regional anesthesia are crucial to successful treatment of this pathology.
Conclusion: Chronic golfer's elbow can be treated successfully with ESWT.

23. Efficacy of Radial Shock Wave Therapy (RSWT) combined with Low Level Laser Therapy (LLLT) in the management of supraspinatus tendinopathies

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Device and producing company: BTL-5000, SWT Power
Introduction: Although the literature demonstrates the effectiveness of RSWT (Radial Shock Wave Therapy) or LLLT (Low Level Laser Therapy) in the treatment of tendinopathies, there is still no work to assess the combination of these two methods. The purpose of this study is to demonstrate that the association of RSWT and LLLT is effective in the management of painful shoulder due to supraspinatus tendinopathies.
Methods: In a multicenter study the authors treated a group of patients suffering from degenerative tendinopathies of supraspinatus by combining RSWT and LLLT using a BTL-5000 SWT Power device. The protocol consists of 4 treatments in weekly sessions. The parameters of RSWT in each session are 3000 shocks at a pressure of 5 bars and a frequency of 18 Hz. With regard to LLLT, the authors treated an area of 25 cm2 at 20 J/cm^2 for 15 minutes. The LLLT immediately follows the RSWT. All patients were assessed before

treatment and at 1 month follow-up by Constant score, SF-36 and computerized analysis of movement.
Results: The combination of RSWT and LLLT is effective in the treatment of supraspinatus tendinopathies from a clinical point of view, from a functional point of view and from the point of view of quality of life perceived by the patient. By comparing the results with those in literature for each individual method it is possible to evaluate that the combination improves the results and reduces treatment time considerably. The therapy is well accepted by patients and free of side effects.
Discussion: The combination of RSWT and LLLT offers faster and more effective treatment due to:
• anti-inflammatory effect
• analgesic effect
• anti-oedematous effect
• acceleration of the healing process
• enhancement of tendon quality
Conclusion: This study (level III of evidence according to EBM), is important because it lays the groundwork for the organization of more detailed work, which could provide a comparison of this combined therapy with individual therapy or with other alternative therapies (for example ESWT) by prospective controlled single- or double-blinded studies.

24. Controversial Results in the Treatment of Lateral Epicondylitis of the Humerus up to now - Reasons?

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3) Orth. und unfallchirugische Abt. St. Marien Hospital, 67067 Ludwigshafen, Germany
Device and producing company: Piezoson 100, Wolf, Knittlingen, Germany
Introduction: Epicondylitis is a painful enthesiopathy of the lateral (radial) or medial (ulnar) epicondyle of the humerus. Origination of the insertion of the tendons by desmoid ossification is distinctly different from that of epiphyseal ossification. Diaphysis involves the insertion site with periosteum (desmoid ossification) whereas epiphysis involves the insertion site without periosteum. A membrane lamination of fibro cartilage similar structure is located between the tissue of the tendon and the cartilage. Their chondroid cells are covered by a scissos-like forming fibro lamellar layer and they grow vertically into the bone. The epiphyseal processes are chondric preformed. Adaption of the different elasticity coefficients of tendon and bone tissue by intercalation of cartilage tissue is required. Pathologic changes in this area result in a so-called tendo-chondro-osteopathy.
The difference between primary and secondary tendo-chondro-osteopathy is that primary enthesiopathies are characterised by their pathologic disorder directly in the local structures whereas secondary enthesiopathies have their origin in the surrounding structures or systematic disorders. Only the primary enthesiopathy can be successfully treated by extracorporeal shock waves.
Methods: Evidence of mechano-transduction: We were able to demonstrate that the therapeutic energy source we used in the treatment of the lateral epicondylitis markedly influenced the migration and proliferation ability of adult stem cells as a function of impulse,

frequency and power. In addition to other factors, tissue-specific stem cells are necessary for tissue repair.
Results: A setting of 1000 impulses at approximately 20 MPa and an energy flux density of 0.08 mJ/mm² (setting 2-3) with the Piezoson 100 and a frequency of 4 Hz were found to be most effective.
Discussion: Under these conditions we have detected in in-vitro trials. We treated 83 patients with an average age of 42.3 years and duration of symptoms 20.6 weeks. Subjective pain sensation prior to therapy was VAS = 7, and 6 weeks after therapy was VAS =1.5
Conclusion: Under the right conditions ESWT is useful for lateral epicondylits and produce good results.

25. Treatment of calcifying tendinitis of rotator cuff with ESWT

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Device and producing company: STORZ
Introduction: Calcifying tendinitis is a disease characterized by the presence of multifocal calcified deposits inside tendon tissue accompanied by severe pain and painful functional limitation. The goal of therapy is to resolve the acute muscle spasms, reduce pain and prevent joint stiffness.
Methods: The study included 20 patients with a follow up of 3 months.
Treatment with shock waves showed positive results in 70% of cases. Our experience is focused on chronic calcifications smaller than 1 cm, which respond well to treatments of 4 to 5 ecography-supported sessions. The majority of patients had previously tried other medical treatments such as fans, steroid infiltrations or physiokinesiotherapy. Usually, 2500 pulses are given weekly for 4 weeks, with energy levels of 0.2 to 0.4 mJ/mm^2 depending on the severity of the disease. After treatment, mobilization is performed aiming initially to reduce muscle contracture, recover the elasticity of capsule-ligamentous structures and normalize and maintain the joint function of the shoulder thereby strengthening and restoring the muscles of the rotator cuff.
Results: The assessment showed a gradual diminishing of pain, disappearance of calcification (in 47% of cases) or a partial resorption (38%). The ranges of motion have significantly improved in over 70% of the patients.
Conclusion: Ultrasound shows a reduced thickness of the tendon. Based on the data collected, its effectiveness, non-invasiveness and absence of side effects, shock wave therapy must therefore be considered a valuable treatment for calcifying periarthritis of the shoulder.

26. Effectiveness of Shock Wave Therapy in Patients with Calcifying Tendinopathy of the Shoulder

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2) Cortrel, Rio de Janeiro, Brazil
3) Orthomaster, Sao Paulo, Brazil

Device and producing company: Reflectron, HMT

Introduction: Three Brazilian centres for shock wave therapy participated in a retrospective study to evaluate the effectiveness and safety of shockwave treatment in patients with calcified tendinopathy of the shoulder.

Methods: In a retrospective and multi-centre study, 222 patients were evaluated (233 shoulders) over a period of 79 months, from April 2001 to November 2007. Eleven patients received bilateral treatment. One hundred and twelve (112) women and 110 men were treated, with ages ranging from 25 to 79 years and an average age of 53 years. Each patient was treated, after subacromial bursa or interscalene brachial plexus block anaesthesia, with 1500-2000 pulses of shockwaves at 35 mm focal depth and with a energy flux density of 0.14 mJ/mm^2. Only one treatment was required in 194 shoulders (83.2%), whereas 30 (12.9%) received a second treatment and 9 (3.9%) received a third. The subjective analysis of pain was obtained through visual analogical scale and the clinical evaluation in accordance with Roles and Maudsley Score at 45, 90 and 180 days after the final treatment.

Results: One hundred and eighty (180) days after treatment the results were classified as: excellent in 28.3%; good in 36.9%; acceptable in 11.6% and poor in 23.2% of the patients. Six patients with bad results were advised to have surgery.

Discussion: Extracorporeal shock wave therapy produces significant relief of pain and decreases physical incapacity produced by calcifying tendinopathy of the shoulder.

Conclusion: Shock wave therapy should be considered as an option in cases of calcifying tendinopathy of the shoulder that failed conservative treatment or surgery.

27. The Effectiveness of ESWT in Comparison with Usual Conservative Treatments in Subacromial Impingement Syndrome (SIS): Results of a Long-Term, Prospective, Single-Blinded, Randomized Clinical Trial

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Device and producing company: MODULITH® SLK, Storz Medical AG, Switzerland

Introduction: Subacromial impingement syndrome (SIS), with pain and limited motion, is a frequently encountered shoulder disorder. The aim of this prospective, single-blind,

randomized clinical trial was to compare the effectiveness of focused extracorporeal shock wave therapy (ESWT) to the usual conservative approaches at long-term follow-up.
Methods: One-hundred and twenty patients (Group 1, n = 60; Group 2, n = 60) with a confirmed stage I-II SIS, according to the Neer classification, were treated either by 3 sessions of ESWT (Group 1, age 58.2 ± 10.8 years), or by a standardized regimen of conservative treatments (Group 2, age 54.1 ± 12.1 years). Follow-up examinations were scheduled at short, mid and long term. Outcome measures were the same for both groups and included Visual Analogue Scale, Constant-Murley score, and a subjective clinical evaluation scale.
Results: Both groups experienced a decrease in pain and an increase in shoulder function at short and mid-term follow-up, whereas the ESWT group (Group 1) demonstrated a significantly higher improvement at long-term follow-up.
Discussion: We obtained significantly better results in the ESWT group (Group 1) at the mid and long-term follow-up, with satisfactory results in 75.4% and 80.7% of the patients, respectively as compared to 52.3% and 40.9% in Group 2, respectively.
Conclusion: ESWT is an effective approach for the treatment of SIS, with better results than the typical conservative approach at short and mid-term follow-up.

28. Eccentric loading plus radial shock wave therapy in the treatment of chronic patellar tendinopathy

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Device and producing company: Swiss Dolorclast, EMS
Introduction: Tendon diseases constitute an increasingly important problem in medicine and sport rehabilitation fields. When speaking specifically about patellar tendon pathology, Blazina and colleagues in 1973 first used the term “jumper's knee” to describe patellar insertional tendinopathy, a condition that affects approximately 20% of athletes for whom jumping is the most important sport drill. Although the majority of conventional treatments produce poor results, many are offered to patients with this pathology. Nevertheless some treatment methods are based on basic evidence and have been investigated with randomized controlled trials (RCT). Low-energy shock wave therapy (rESWT) and eccentric loading (EE) recently have demonstrated therapeutic effectiveness. The aim of this study is to analyze the results obtained with the combined application of both procedures (rESWT + EE) in patients with chronic patellar tendinopathy.
Methods: Thirty patients with chronic patellar tendinopathy for more than four months and who showed poor or no results from conservative treatment, which could include physiotherapy, prescription of NSAIDS or the injection of corticosteroids, were evaluated in the areas of pain, function and activity according to the VISA, Score Grading Patellar Tendinosis (Victorian Institute of Sport Assessment, Australia), using the non-parametric test of Wilcoxon dependent samples for evaluation. All the patients received 3 weekly sessions, of 2000 impulses, with an intensity of 2.5-3.5 bar (energy flux density = 0.1-0.16 mJ/mm^2) and a frequency of 8 Hz. In addition to this, patients were fully informed about the protocol of eccentric training based on the study of Jonsson and Alfredson (Br. J. Sports Med. 2005; 39; 847-850).
Results: Four months after the initial evaluation, the VISA score demonstrated an increase from 52 to 82. Twenty-three of the 30 (76%) patients reported excellent or good results

according to the Roles and Maudsley Scale. The return to sport activity for this group was an average of 51.3 days.
Conclusion: The combination of radial shock wave therapy (rESWT) and eccentric loading (EE) demonstrated improvement in function and activity, as well as diminution of pain, signifying it as a good alternative for conservative treatments on chronic patellar tendinopathy. Future randomized controlled studies are necessary to confirm the results of this investigation.

29. Effectiveness of ESWT in Patients with Chronic Patellar Tendinopathy

Paulo Roberto Rockett, M. Lui

Institution:
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Device and producing company: Reflectron, HMT
Introduction: Patellar tendinopathy is not merely an inflammatory condition, it is also due to the degeneration of the collagen fibers. The results of conservative treatments have been irregular and inconsistent and the symptoms frequently recur. Surgery has been suggested as an alternative method for treatment of severe cases that do not respond to conservative treatments however, the results of surgery are incalculable and associated with risks and complications.
Methods: Thirteen patients (16 knees) were included in the study; 12 men and 1 woman, between 26 and 67 years old (average age: 38 years old). Each patient was treated, after regional block or local anaesthesia, with 1000 pulses of shock waves at 5 mm depth focus and 0.13 mJ/mm^2 energy flux density. The subjective analysis of pain was accomplished by visual analogical scale and the clinical evaluation in agreement with the Roles and Maudsley Score.
Results: One hundred and eighty (180) days after treatment we obtained satisfactory results in 75% of the cases (44% were excellent and 31% were good results) and poor results in 25% of the patients.
Discussion: Extracorporeal shock wave therapy produces significant relief of pain and decreases physical incapacity caused by chronic patellar tendinopathy.
Conclusion: Shock wave therapy should be considered as a treatment option in cases of chronic patellar tendinopathy that failed conservative or surgical treatments, because it is safe, non-invasive and without significant complications, and it reduces the risks of a surgical procedure and the involved operational costs.

30. ESWT for Patellar Tendinopathy

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Device and producing company: Not applicable
Introduction: Extracorporeal shock wave therapy (ESWT) has become a popular treatment for patellar tendinopathy. The purpose of this review was to study the effectiveness of ESWT

treatment in patellar tendinopathy, to attempt to come to recommendations for an effective treatment protocol, and to identify topics for further research.
Methods: A computerized search of the Medline and Embase databases was performed on August 1, 2007, to identify studies dealing with the effects of ESWT on patellar tendinopathy.
Results: Seven articles describing the effectiveness of ESWT on patellar tendinopathy, all published after 2000, were included. These studies included a total of 283 patients (298 tendons), of whom 204 (215 tendons) were assigned to ESWT treatment. The treatment results were positive but most studies had methodological deficiencies, small numbers and/or short follow-up periods. Method of application and shock wave generation, energy level, the number and frequency of treatment sessions, the use of (local) anesthesia and the method of localization were variable.
Discussion: ESWT seems to be a safe and promising treatment for patellar tendinopathy with a positive effect on pain and function. Based on the current knowledge it is impossible to recommend a specific treatment protocol. Further basic and clinical research into the working mechanism and effectiveness of ESWT in patellar tendinopathy are necessary (for example the ongoing Dutch TOPGAME-study).
Conclusion: Because ESWT treatment seems to have a positive effect on pain and function, it could be part of a rehabilitation program for patellar tendinopathy.

31. Effectiveness of Shock Wave Therapy in Patients with Pes Anserine Bursitis

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Institution:
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Device and producing company: Reflectron, HMT
Introduction: Pain in the conjoined insertion of the sartorius, gracilis and semitendinosus muscles is also recognized as pes anserine bursitis and is frequently found in clinical practice. Paradoxically, there is evidence that many times the presence of pes anserine bursitis is not identified. The objective of this study is to present our experience in the treatment of pes anserine bursitis with shock wave therapy.
Methods: Twenty-eight (28) patients diagnosed with pes anserine bursitis were treated with shockwaves between May 2002 and January 2008. Six patients had bilateral syndrome for a total of 34 cases. These patients were 6 men and 22 women, with ages ranging from 25 to 81 years and an average age of 53 years. After nerve block or local anaesthesia, the patients received 1000 pulses of shock waves with focus depth of 5 mm and energy flux density of 0.13 mJ/mm^2. The subjective analysis of pain was determined by visual analogical scale and the clinical evaluation was in agreement with Roles and Maudsley Score.
Results: One hundred and eighty (180) days after the treatment, the results were: excellent in 44.2%; good in 38.2%; acceptable in 2.9% and poor in 14.7% of the patients.
Discussion: Extracorporeal shock wave therapy produces significant relief of pain and decreases physical incapacity caused by pes anserine bursitis syndrome. ESWT should be considered as a treatment option for patients unresponsive to other conservative measures.
Conclusion: Shock wave therapy is a safe and effective non-invasive treatment for patients with pes anserine bursitis.

32. Effect of Radial Extracorporeal Shock Wave Therapy for Overuse Injury in Athletes

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Device and producing company: Swiss Dolor Clast, EMS

Introduction: Overuse injury is a common cause of athletes' complaints about pain and is often difficult to treat. Traditional non-operative treatment consists of rest and the administration of NSAIDS. Some studies have suggested different types of therapeutic interventions such as steroid injection, sclerosing therapy and aprotinin injection. Recently, extracorporeal shock wave therapy (ESWT) has been reported to be effective for the treatment of sports injuries. The purpose of this study was to evaluate the efficacy of radial extracorporeal shock wave therapy (rESWT) in the treatment of athletes with overuse injury.

Methods: Sixty-nine athletes with overuse injury were treated with rESWT (13 epicondylitis of the elbow, 8 plantar fasciitis, 15 chronic Achilles tendinopathy, 21 jumper's knee and 12 tendinitis of the rotator cuff), 43 males and 26 females, aged between 20 and 35 years (mean age: 23 years). All patients must have undergone clinical diagnosis and had been treated unsuccessfully for at least 3 months, including local injections and non-steroidal anti-inflammatory drugs and physiotherapy. The evaluation consisted of assessments of pain (Visual Analogue Scale, VAS) and functional impairment. The patients were treated in 3-5 sessions (at intervals of 5-7 days, mean 6 days) with 1,500-2,500 impulses per session. Device used was the Swiss Dolor Clast (EMS, Switzerland) and the energy flux density was 0.06-0.12 mJ/mm^2. The patients received no anesthesia, the energy level was determined by the maximum pain induced by ESWT that could be tolerated by each patient. The pain on palpation of the injury point and pain during daily activity were evaluated at each examination. Evaluation was performed at 0, 1, and 2 weeks and 1, 2, and 4 months post-initiation of therapy. At the end of follow-up, the patients were asked to assess their level of residual pain compared with pain before treatment.

Results: We obtained satisfactory results in 86.5% of cases (67.2% had excellent results and 19.3% showed good results), with an average time of approximately 4 weeks for resuming sport. Patients showed a considerable pain level decrease 1-2 weeks after the treatment (to the palpation $p<0.05$ and during daily activity $p<0.05$) and a further decrease in the subsequent examinations (to the palpation $p<0.01$ and during daily activity $p<0.01$). No obvious side effects were observed.

Conclusion: The outcome of the described rESWT treatment appears to be satisfactory and confirms its role in the treatment of athletes with overuse injury.

33. Low Energy Extracorporeal Shock for Chronic Greater Trochanteric Pain Syndrome (GTPS)

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Device and producing company: EMS DolorClast
Introduction: Lateral hip pain is a frustrating condition encountered regularly by primary care physicians and orthopedists. The aim of this study was to determine whether low-energy SWT is a safe and effective management modality for chronic GTPS.
Methods: Thirty-three patients with chronic GTPS received low-energy SWT (SWT Group; 2000 shocks; 4 bars of pressure which is equal to 0.18 mJ/mm^2, total energy - 360 mJ/mm^2). Thirty-three patients with chronic GTPS were not treated with SWT, but received additional forms of non-operative therapy (control group). All SWT procedures were performed without anesthesia. Evaluation was by change in visual analog score (VAS), Harris Hip Score (HHS) and by Roles and Maudsley score.
Results: Mean pre-treatment VAS scores for the control and SWT groups were 8.5 and 8.5, respectively. One month, 3 months, and 12 months after treatment, the mean VAS for the control and SWT groups were 7.6 and 5.1 (p8 (p and 57.6 and 79.9 (pfinal follow-up, the number of excellent, good, fair, and poor results for the SWT and control groups were 10 and 0 (phe percentage of patients with excellent (“1”) or good (“2”) Roles and Maudsley scores (i.e. successful results) 12 months after treatment was statistically greater in the SWT group compared to the control group.
Discussion: The present study evaluated the effects of SWT on a consecutive series of patients with GTPS who had not responded to nonoperative management. The outcome for the entire population was evaluated and compared to a well matched control group. The mean VAS and HHS for the SWT group were statistically improved at 1, 3, and 12 months after treatment compared with the control group. The percentages of excellent or good results 12 months post-treatment for the SWT and control groups were 79% and 36%, respectively. There were no significant complications, and no patient required additional shock wave therapy. The results from this study add to the growing number of favourable reports that substantiate the efficacy of SWT as an effective treatment for chronic tendinopathies.
Conclusion: SWT is an effective treatment for GTPS.

34. ESWT for AVN of the talus
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Device and producing company: DolorClast®, EMS
Introduction: The talus is predisposed to AVN or bone death due to ischemia owing to its unique structure characteristic extraosseous arterial sources and variable intraosseous blood supply. Neither surgical operation nor conservative treatments are very effective.
Methods: We used an EMS DolorClast®, a radial extracorporeal shock wave therapy machine (made in Switzerland) to treat the patient with an energy flux density of 0.12 ~ 0.16 mJ/mm^2. The impact points were chosen dependent on the pain location, 200 shocks at each point. Five treatments were performed.
Results: One year later the symptoms were markedly relieved and no complications were observed. The MRI also changed significantly. It showed that the low-signal-intensity segment in the talar dome was reduced and the articular surface was clearer than before.
Discussion: Shock waves can increase the pain threshold. Shock waves might generate micro-fractures to promote bone healing and the formation of new local microcirculation due to angiogenesis. Shock waves traveling through different tissues can generate mechanical

stress at the interfaces with the effect of tensile and pressure stress on the cells. Tensile stress can cause the release of growth factors promoting microcirculation.
Conclusion: Extracorporeal shock wave treatment provided beneficial effects for this problem. This novel treatment modality resulted in significant pain relief and functional improvement.

35. Spontaneous Osteonecrosis: Long-Term Effectiveness of Extracorporeal Shock Wave Therapy in the Treatment of Early Spontaneous Osteonecrosis of the Knee: a 2-year follow-up

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Device and producing company: Piezoson 300, Wolf
Introduction: This work reports the results of fifteen cases of early spontaneous osteonecrosis of the knee successfully treated with extracorporeal shock wave treatment (ESWT). Due to its neo-angiogenic effect, ESWT can be suggested as an effective conservative treatment for spontaneous osteonecrosis of the knee.
Methods: Fifteen patients with medial femoral condyle osteonecrosis of the knee (one bilateral) were evaluated. Two patients had received a femoro-popliteal by-pass within the previous year, while five others presented with a deficit of the vascular axis of the homolateral lower limb documented by echo-colordoppler. A clinical evaluation was taken during initial diagnosis using KSS, McGill Pain Questionnaire (PPI, NRS, VAS). Plain radiographs, radioisotope bone scan and MRI confirmed the diagnosis of osteonecrosis. Patients were treated with a cycle of three ESWT sessions of 2000 pulses at 0.28 mJ/mm^2 delivered by a Piezoson 300 (Wolf) at 6.5 MHz performed in a one-month period. A clinical evaluation including MRI was performed one month, three months and 2 years after the treatment.
Results: The clinical evaluation showed significant improvement of the symptoms (the continuity of the cartilage with a reduction in bone marrow edema and no collapse of the lesion).
Discussion: The most effective treatment for osteonecrosis lesions without evidence of structural collapse is conservative treatment, with rest and no weight bearing. In our study, a single cycle of ESWT produced an improvement of the clinical and MRI aspects in eleven cases of spontaneous medial femoral condyle osteonecrosis of the knee. The neo-angiogenic effect of ESWT appears to accelerate the time required to decrease the symptoms.
Conclusion: ESWT might have the potential to curtail the progression of the disease and to avoid the need for surgical treatment.

36. Use of Shock Waves in Osgood-Schlatter Disease

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Device and producing company: Evotron, HMT Italy
Introduction: Osgood-Schlatter disease often is encountered in young athletes. The etiology is unknown, but it is thought to be secondary to repetitive microtrauma. Patients often have anterior knee pain, exacerbated with sporting activities. Radiographs may reveal fragmentation and irregular ossification at the tibial tubercle.
Based on our experience, we optimized the shock wave rehabilitation treatment protocol using the HMT Evotron electro-hydraulic device.
Methods: A total of 48 young athletes (age 10 ±15 years) were treated with six sessions of shock waves at low frequency. Subjects did not accept the traditional protocol of cessation of sporting activities. In all subjects we reported maximum pain intensity [VAS] on both the clinical and functional scale after each session of shock wave treatment. At the beginning and end of treatment, telethermography and point-thresholds [PaTh] subsequent to pressure with Fischer algometer (value from 0 to 20, 5kg/cm^2) were recorded. Inclusion criteria was duration of anterior knee pain, VAS of more than 8 to load, functional limitation, and signed informed consent document.
Results: Clinical examination and clinical functional scale show the functional recovery. The framework static and dynamic thermography showed a trend towards normalization of the painful areas. At the end of all treatments VAS decreased (8.5 to 2,2±0.6,p).
Discussion: After the first month of therapy, patients could resume practice of sporting activities and they have suitability for the agonistic activity at the end of treatment. Recurrence in 6.85% of cases did not cause interruption of resumption of sports.
Conclusion: The shock wave treatment protocol allowed us to achieve good results especially in sports athletes, without them having to refrain from competitive activities. Additional benefits included the absence of contraindications and the non-invasive nature of the treatment.

37. Defocused shockwave therapy and hip osteoarthritis

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Device: Storz
Introduction: Coxalgia is the main symptom of hip osteoarthritis (OA) and leads to loss of function as well as disability. Nevertheless, it is not specific to hip OA and can also be present in other conditions such as tendinitis of the hip region (periarthritis of the hip or “frozen hip”) or “irritable hip syndrome”. In addition to standard strategies for the treatment of hip OA, in the present study we have tested local application of defocused shock waves to hip joints and periarticular structures in order to better define their possible role in the treatment protocol for this condition. Their anti-inflammatory effect, effect on pain and ability to induce muscle relaxation may be responsible for improvement of symptoms. Cartilage regeneration, depending on their positive effect on tissue trophism, has also been demonstrated (B. Moretti et al.).

Methods: In this study we enrolled 50 patients, 27 females and 23 males, aged from 48 to 64 years (mean age 56 years), diagnosed with either idiopathic or secondary hip OA on standard radiograms (28 belonging to stage I and 22 to stage II). Our patients were evaluated using the Harris Hip Score (HHS) and received standard X-rays at their first hospital admission, at the end of the treatment and 6 and 12 months after the end of the treatment. All patients had been suffering from coxalgia (32 right hip, 14 left hip, 4 bilateral) for 9 to 28 months: 30% had tried both medical (non-steroidal anti-inflammatory drugs and/or other analgesic drugs) and physical (magnet therapy, ultrasound therapy, TENS or iontophoresis) therapies; only 2% had practised associated kinesiotherapy.
Our protocol consisted of at least 4 (maximum 6) defocused shock wave applications (2,500 to 4,000 shocks - energy level 0.1- 0.15 mJ/mm²), depending on the severity of pain, with an interval of 2 to 3 days between two applications. There was no need for local anaesthetics as the treatment was well tolerated by the patients. After each shockwave application, patients were treated with kinesiotherapy consisting of gradual stretching of the periarticular muscles, joint specific stretching ("pompage") and careful articular mobilization. This rehabilitation protocol was carried on for an additional 16 weeks after the end of the shockwave treatment and consisted of 3 cycles of 4, 8 and 4 weeks, respectively:
I cycle (4 weeks, 5 days a week)
Deep Trasverse Massage (DTM) of the muscles of the thigh
Prolonged stretching sessions (each posture > 2 minutes) of the flexor and adductor muscles of the hip
DTM of perimalleolar regions
Passive articular mobilization and decoaptation
Lymphatic drainage of lower limbs
Back stretching postures
II cycle (8 weeks, 3 days a week)
Prolonged stretching sessions (each posture > 2 minutes) of the involved muscles
Isometric exercises
Active kinesiotherapy
Proprioceptive Neuromuscular Facilitation exercises
Postural exercises
Gait rehabilitation
III cycle (4 weeks, home rehabilitation)
Global muscular stretching
Isotonic exercises
Exercises for motor coordination
During the final stages of the study, we recommended the correct lifestyle to our patients in order to avoid additional physical stress.
Results: In the present study we used defocused shock wave therapy to treat antalgic muscular contractures secondary to hip OA. After the treatment we observed a general improvement of symptoms and dysfunction in all the patients included in the study (mean HHS before the treatment of 64, mean HHS after the treatment of 92). Unfortunately the effect of the treatment was diminished at 6-month follow-up (mean HHS of 82) and even more so at 1 year (mean HHS of 77). No significant changes were evidenced in X-ray scans and/or MR images, which showed a progression of the articular degenerative process in 34% of cases.
Discussion:
The protocol associating defocused shockwave therapy and kinesiotherapy was able to reduce pain and disability in stage I and II hip OA.

Defocused shock wave therapy seems to be more effective than focused shock wave therapy in reducing periarticular muscle contractures and is better tolerated by the patients even at high energy levels.
The positive effect on symptoms and function tends to decrease over time due to the progression of cartilage degeneration that is not influenced by the therapy.
The treatment can be repeated in the absence of specific contra-indications, as it is well tolerated and has very limited side effects. This postpones the need for surgery.
This protocol does not prevent resorting to surgical treatment, if necessary.

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38. Extracorporeal Shock Wave Therapy in Post-Traumatic Myositis Ossificans

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Device and producing company: Ossatron, HMT s.r.l

Introduction: Myositis Ossificans (MO) is quite a common development in sports activity and can be due to direct trauma or to repeated micro-injuries. Symptomatology presents persistent pain in association with a reduction in range of motion. The traditional therapeutic approach uses a variety of treatments, such as physical therapy, that produce insufficient successful clinical evidence. The latest therapeutic option is surgical removal of the MO.

Methods: We present a literature review concerning MO treatment. We illustrate the case of a 15-year-old soccer player, presented to our department six months after a blunt contact injury during sports activity. After several months of aggressive physiotherapy, physical and pharmacologic traditional treatments with no functional improvement, the patient was treated with one session of Extracorporeal Shock Wave Therapy (ESWT) and with physiotherapy analogous to the former treatment regimen.

Results: In literature we did not find any articles referring to ESWT treatment of MO. At four months following the therapy, the athlete evaluation showed, normal range of motion and no signs of weakness. Six months after treatment the patient resumed playing soccer regularly with his team.

Discussion: The ESWT approach avoided pharmacological and surgical treatment and allowed for a complete and early recovery to full sports activity. Although the patient's clinical condition clearly improved and he made full recovery, this did not show up on the X-ray or Magnetic Resonance Imaging evaluation.

Conclusion: ESWT appears to be a valid and interesting therapeutic option for post-traumatic MO.

39. Shock Wave therapy for POA

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Device and producing company: Modulith SLK, Storz

Introduction: POA frequently occurs in patients suffering from myelin or other neurologic injuries, with an incidence rate of about 10%. The POA evolution generally stabilizes in 1-2 years. POA reduces ROM of hip, knee and elbow, limits the patient's autonomy and increases complications.

Methods: We treated 56 patients with 65 POA's with SW therapy. Eighteen patients were hemiplegics, 14 paraplegics, 4 tetraplegics and 9 post-coma. The POA distribution was: 44 hips, 16 elbows and 5 knees. The patients were treated with 1 or 2 sessions of SW, with 6,000-8,000 shocks at 0.4-0.6 mJ/mm^2. After SW therapy, the patients had several sessions of kinesiotherapy.

Results: Follow-up after one month for 45 patients (52 POA's): 87.5% of the patients treated within 18 months from the injury showed an improvement of the ROM. Only 59% of the patients treated later than 18 months after the injury had improvement of the ROM.

Discussion: Literature indicates surgery as the standard of care for POA. However, these operations are complex procedures and relapses are frequent. ESWT can achieve similar results without surgery. It produces the best results when POA's are still in evolution and when followed by appropriate kinesiotherapy.

Conclusion: The POA treatment described has shown encouraging results.
This treatment features limited costs and is easy to apply. Additional advantages are no contraindications and no trauma for the patient.

40. Preliminary results of Extracorporeal Shock Wave Therapy in patients with Achilles tendinopathies

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Device and producing company: Duolith SD 1, Storz Medical

Introduction: Chronic Achilles tendinopathy is a painful condition often showing unsatisfactory results with conservative treatments. The aim of this study was to evaluate the effect of extracorporeal shock wave therapy (ESWT) in chronic Achilles tendon disorders.

Methods: Sixteen subjects participated in this study, aged between 19 and 35 years (mean age: 27.8 years). All participants underwent clinical and instrumental diagnosis (X-rays and ultrasonography). They had been previously treated with physical therapy, local injections, and other conservative procedures for at least 6 months. Focused and Radial ESWT (Storz Medical, Duolith SD1) were assigned to 3 treatments, 1 per week for 4 weeks. In each session, 1000 pulses of 0.1 to 0.15 mJ/mm^2 and 3000 pulses of 1.4 to 2.1 bar, depending on the participant's pain tolerance, were administered respectively. The control was the contralateral limb. Pain was measured on a visual analogue scale (VAS). The functional ability was evaluated using one leg standing test (OLST) and single limb hopping course

(SLHC) on each subject before treatment, during treatment and 4 weeks after the treatment period.
Results: The treated ankles displayed improvement in all of the parameters (VAS, OLST, SLHC) analyzed during the treatment and at 4 weeks. Four weeks after extracorporeal shockwave therapy, pain measured on a visual analogue scale (VAS) decreased significantly in ankles with chronic Achilles tendon disorders. We found similar results in OLST and SLHC for both the treated and control ankle comparisons after treatment.
Conclusion: Extracorporeal shock-wave therapy appears to be a supplement for the treatment of chronic Achilles tendinopathy.

41. Preliminary Results in the Treatment of Achilles Tendinopathy by Application of SWT Combined with Microdebridement Radio Frequency (Topaz(r))

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Device and producing company: EPOS ULTRA, Dornier Medtech
Introduction: Intratendinous degeneration of the Achilles tendon (noninsertional portion) presents a challenge for any noninvasive treatment method, which should trigger a process of quality sustained repair and the consequent formation of a connective-fibrilar tissue similar to the original. In this study, we try to evaluate the combination of two methods: shock wave therapy and microdebridement radiofrequency (TOPAZ).
Methods: A prospective study was performed between October 2008 and February 2009, which included three cases of male patients in whom the intratendinous portion of the Achilles tendon was severely affected with tendinosis over the distal third of the tendon. They were evaluated clinically and with ultrasound before and after treatment. Initially high focal energy shock waves were applied, then fifteen days after microdebridement was performed a second session of shock waves was given. Immobilization is achieved with a cast above the knee for approximately four to six weeks.
Conclusion: This study allowed us to show that combining these two treatment methods provides possible noninvasive treatment for the management of this pathology when the surgical alternative represents a technically difficult option.

42. Effectiveness of Shock Wave Therapy in Patients with Chronic Achilles Tendinopathy

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Device and producing company: Reflectron, HMT

Introduction: A pathological Achilles tendon may in itself be symptomatic causing clinical morbidity or it may be the precursor of a catastrophic rupture. Three Brazilian centers for shockwave therapy participated in a retrospective study to evaluate the effectiveness and safety of shock wave treatment in patients with chronic tendinopathy of the Achilles tendon.
Methods: One hundred forty-two (142) patients were evaluated (156 Achilles tendons) from May 2002 to November 2007. Each patient was treated after medial and lateral regional block anaesthesia, with 1000 pulses of shockwaves at 5 mm depth focus and 0.13mJ/mm^2 energy flux density. Only one treatment was required in 123 cases (78.8%), whereas 23 cases (14.8%) were subjected to a second treatment and 10 (6.4%) received a third treatment. The subjective analysis of pain was determined by visual analogical scale and clinical evaluation in agreement with the Roles and Maudsley Score.
Results: One hundred and eighty (180) days after treatment the results were classified as: excellent in 28.8%; good in 40.4%; acceptable in 15.4% and poor in 15.4% of the patients. Minimal collateral effects were observed, related to transitory petechias and a few cases of initial worsening of pain after treatment. We did not observe any cases of worsening of the initial complaints. Three patients with bad results were advised to have surgery.
Discussion: Extracorporeal shock wave therapy produces significant relief of pain and decreases incapacity produced by chronic Achilles tendinopathy.
Conclusion: Shock wave therapy should be considered as an option for patients with chronic Achilles tendinopathy unresponsive to other conservative measures before undergoing surgery.

43. Comparison of Growth Factors and Shock Wave Therapy for Chronic Insertional Achilles Tendinopathy

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Device and producing company: HMT (Producing Company) Evotron (Device)
Introduction: Shock wave therapy and Plateled concentrate injections are two non-invasive methods to treat chronic insertional Achilles tendinopathy.
Methods: We treated 15 patients with chronic recalcitrant Achilles tendinopathy with use of shock wave therapy and 15 patients with use of shock wave therapy and growth factors injections. The follow-up protocol included 1, 3 and 6 months controls including clinical findings and echography exam of Achilles tendon.
Conclusion: Two conservative methods showed an important therapeutic effect in the Achilles tendinopathy in general and pain assessment.

44. ESWT in Stress Fractures

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Device and producing company: Minilith SL1, Storz Medical-Italy
Introduction: In soccer players, lower extremity stress fractures are common injuries and are the result of repetitive damage that exceeds the intrinsic ability of the bone to repair itself. They may be treated conservatively, but this may cause long-term complications, such as delayed union, muscle atrophy and chronic pain. Stress fractures that fail to respond to this management require surgical treatment, which is also not without risks and complications. Shock Wave Therapy has been used successfully on fracture complications, such as delayed union and non-union. Therefore, we want to examine ESWT in the management of stress fractures.
Methods: We present a retrospective study of 10 athletes affected by chronic stress fractures of the 5th metatarsus and tibia that received 3-4 sessions of low-middle energy ESWT.
Results: At the follow-up, the clinical and radiographic results were excellent and enabled all players to gradually return to their sports activities.
Discussion: In the treatment of fractures, usually high energy is used to induce periosteal detachment and trabecular fractures with haemorrhages, which in turn stimulate callus formation and subsequent fracture healing. We chose to use lower energy ESWT on the rationale that ultrasound induces nitric oxide liberation at low energy. There is a link between NO and osteogenesis via the seven-day expression of the core binding factors cbfa1. Consequently, our application of lower energy shock waves stimulates bone growth by nitric oxide production.
Conclusion: These reports show that ESWT is a non-invasive and effective treatment for resistant stress fractures in soccer players.

45. Non-union and shock waves: the option.

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Device and producing company: Dornier epos/ Ossatron
Introduction: Since 1996 shock waves have been one of the principal treatments for non-unions in our medical unit. It is now a common alternative treatment for non-unions with a new model of prediction of the outcome. With power Doppler we detect the problem and select the proper treatment site. We present the summary of our experience of the last four years.
Methods: Two different shock wave systems were used. From 1996 to 2006 we used an electro-hydraulic system and since 2006 we have been using an electromagnetic system. First we used x-rays and later ultrasound for targeting. We evaluate the final results of 60 patients with x-rays and ultrasound after one, two, three and six months.
Results: Mean age of the patients: 43.2 years; mean age of the non-union: 9 months; previous surgery: 97%; consolidation with electro-hydraulic system: 55.4%; consolidation with electromagnetic system: 75%.
Discussion: We will discuss the different methods of treatment (electromagnetic or electro-hydraulic). The main issue is to locate the proper treatment site and the to treat only fractures younger than months of evolution.

Conclusion: ESWT is an efficient treatment for non-unions. Ultrasound is the best method of focus. The selection of the treatment site must be performed with Doppler and ultrasound.

46. Is it possible to treat non-unions with radial shock wave therapy?

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Device and producing company: Dolorclast, EMS

Introduction: The treatment of delayed unions or non-unions with focused ESWT is a common option for these difficult pathologies. The use of Radial ESWT is indicated for soft tissues tendinopathies. We treated some superficial bones with delayed unions with radial shock waves due to economic constraints.

Methods: We performed the treatment as an outpatient procedure without anaesthesia, using X-rays for targeting. We performed 3 sessions with 3000 pulses at 0.2 mJ/mm^2. We treated 2 tibias, 2 metatarsal bones, one distal femur and 2 scaphoids.

Results: After 6 months we observed bony consolidation in six out of seven cases.

Discussion: Radial ESWT is typically not used for bone injuries, but in our opinion, it is a new indication for some very specific cases. More clinical experience is necessary to draw further conclusions.

Conclusion: Radial ESWT is effective for treatment of superficial bone delayed unions.

47. Extracorporeal Shock Wave Therapy for Delayed Healing Fractures and Non-Unions

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Device and producing company: Reflectron, HMT

Introduction: The incidence of non-unions varies tremendously by fracture site but 1-3% of all bone fractures develop into a non-union. Surgical treatment is considered the “gold standard” for the treatment of non-unions however, surgical treatment leads to serious complications, is traumatic for the patient and is very costly. Clinical studies of SWT for treating chronic non-unions have confirmed a success rate of 75% to 91%.

Methods: Since 2002, we have used an electro-hydraulic device (Reflectron - HMT) in a prospective clinical study to investigate the effectiveness of ESW in the treatment of non-unions. Eight patients (one femur, one fibula, one radius, one ulna, one scaphoid and three metatarsals) underwent a single ESW application with local or regional anaesthesia. For all treatments the SW focus was positioned on the gap and between 3,000 and 4,000 pulses were applied (500 pulses per treatment location) with an energy flux density of 0.15mJ/mm^2. Following ESWT the patients were immobilized with a plaster cast or plastic splint.

Results: The results were assessed clinically, and fracture healing was evidenced with plain radiographs and tomography. The bony remodelling of the non-union was achieved in 7 patients with no complications.

Discussion: The success rate seems comparable to that achieved by routine surgical treatment but without serious complications. ESWT is an alternative method of treatment for non-unions.
Conclusion: ESWT must be considered an alternative which presents advantages over surgery. ESWT is not invasive, does not present significant complications, is much less costly and avoids the significant potential risks of traditional surgical procedures.

48. Shock wave therapy in the treatment of non-unions and delayed unions of long bones

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Device and producing company: Modulith SLK by Storz Medical
Introduction: Over the last 10 years, shock wave therapy has changed the treatment approach of many orthopaedic pathologies. In this paper the authors would like to contribute to the international literature by presenting their methodology concerning the treatment of long bones non-unions and delayed unions.
Methods: Ninety-seven patients affected by delayed consolidation and non-union of long bones were treated with shock waves; 58 male and 39 female, average age 42.5 (min. - 17, max. - 72); 43 femurs, 34 tibias, 13 humeri, 4 ulnas, 3 radii. The device used was Modulith SLK by Storz Medical, equipped with radiological computerized aiming system; treatment protocol consisted of three sessions performed every two days, each session consisting of 4000 pulses with energy varying from 0.60 to 0.90 mJ/mm^2. The treatment, which did not need anesthesia, involved progressively increasing the energy and gently manuevering the source to include all the tissue in the focus.
Results: All the patients were examined clinically and with X-rays before treatment and one and six months after treatment.
Final results:
- Femur: 35 cases of total consolidation (83%)
- Tibia: 28 cases of total consolidation (80%)
- Humerus: 11 cases of total consolidation (84%)
- Ulna: 3 cases of total consolidation (75%)
- Radius: 3 cases of total consolidation (100%)

In 35 patients (36%) who presented partial consolidation at one month follow-up (12 femur, 14 tibia, 6 humerus, 2 ulna, 1 radius) a second treatment was performed.
Discussion: We believe the failures were primarily due to the following factors:
1) atrophic non-unions
2) defect of stability of the bone segment
3) distance (> 5 mm) between the bone fragments

Conclusion: The authors consider shock wave therapy the first choice in the treatment of non-unions and delayed unions of long bones; no complications were observed and percentages of success were very high.

49. rESWT in the Treatment of Spasticity in Cerebral Palsy: Randomized, Placebo-Controlled Clinical Trial

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Device and producing company: Swiss Dolor Clast, EMS-Switzerland

Introduction: Spasticity is a disorder of excess muscle tone associated with central nervous system disease. Cerebral Palsy (CP) is a central nervous system deficit resulting from a non-progressive lesion in the developing brain. Although the brain lesions are static, the movement disorders that arise are not and they are characterized by atypical muscle tone, posture and movement. Spastic motor type is the most common form of CP and its conventional therapeutic management may include splinting/casting, passive stretching, facilitation of posture and movement, spasticity-reducing medication, botulinum toxin and surgery. ESWT reduces hypertonia of the wrist and finger muscles in patients affected by stroke (Manganotti 2005). The aim of this study was to evaluate the efficacy and safety of radial extracorporeal shock wave therapy (rESWT) in the treatment of spasticity in patients with cerebral palsy.

Methods: This study is a randomized, placebo-controlled clinical trial that included 15 patients with spastic cerebral palsy; 12 men and 3 women, aged 10-46 years (mean age, 31). The 15 patients presented 40 spastic muscles (6 biceps brachii, 6 wrist flexors, 5 hip adductors, 10 gastrocnemius, 10 soleus and 3 hamstrings). The 40 spastic muscles were divided in three groups using a computerized random-number generator. Group I (14 muscles) received rESWT in spastic muscle. Group II (13 muscles) received rESWT in spastic muscle + rESWT in antagonist muscle. Group III (13 muscles) received placebo via application of a sham rESWT with sound in spastic muscle. Device used was the Swiss Dolor Clast (EMS, Switzerland). The patients were treated in 3 sessions at intervals of one week. Number of impulses was 2000 in each spastic muscle (4000 in Group II). Energy flux density was 0.10mJ/mm^2 (2 bar). Spasticity was evaluated by the Ashworth Scale from 0 to 4 (0: no spasticity to 4: severe spasticity) on the upper extremity muscles. Spasticity was evaluated with a goniometer (passive elongation) on lower extremity muscles. Outcomes were assessed by a blinded evaluator. Evaluation was performed immediately before treatment and at one and two months after treatment. The non-parametric Mann-Whitney U test for independent samples was used for statistical analyses.

Results: There were no significant differences between Group I (rESWT in spastic muscle) and Group II (rESWT in spastic muscle + rESWT in antagonist muscle). However, with regard to the spastic muscles from upper limbs there were significant differences ($p=0.05$) between Group I (rESWT) and Group III (placebo). With regard to the spastic muscles of lower limbs there were significant differences ($p=0.044$) between Group I (rESWT) and Group III (placebo) as well as significant differences ($p=0.043$) between Group II (rESWT in spastic muscle + rESWT in antagonist muscle) and Group III (placebo). Observed side effects were 3 small superficial hematomas, 3 petechiae and 3 patients expressed light pain during the therapy. All side effects were tolerated by all the patients and disappeared after 1-7 days. All the patients finished the study. At the end of follow-up, all the patients were asked to assess if they would repeat the experience and all of them answered affirmatively.

Discussion: The study presents interesting insights on the usefulness of rESWT in treating patients with cerebral palsy to reduce spastic muscle tone. The mechanism of shock wave

therapy on spastic muscles is still unknown. Basic research & larger randomized controlled studies are necessary to support the results of this clinical trial.
Conclusion: rESWT is more effective than placebo in decreasing spasticity of patients with cerebral palsy. Positive outcomes are maintained at least 2 months after treatment.

50. Defocused ESW in treatment of district spasticity in children affected by cerebral palsy with special reference to correction of equinus foot deformity: clinical evaluation of the results with gait analysis integrated

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Device and producing company: Minilith, Storz Medical
Introduction: In children affected by cerebral palsy spasticity concerns primarily the upper limb flexor muscles and the lower limb extensor muscles and is characterized by increased resistance to passive stretching associated with other clinical signs (hyper-reflexia, clones, spasms, synergies, etc…). The rise of pathological postural tone is due to the lack of the first motor neuron inhibition with consequent prevalence of the second one. The Ashworth is the most used functional scale in order to measure the degree of spasticity and is often associated to the "spasms" scale. The gait analysis is a valid method of objective measurement and is useful to supplement the clinical evaluation, especially for information concerning time parameters. The focal therapy of spasticity is addressed not only to the recovery of articular range of motion but above all to functional and hygienical purposes. The improvement of paretic limbs functionality often leads indirectly to the improvement of the higher functions such as language and learning. Different techniques are used in the treatment of spasticity: FKT, neuromuscular blocks, functional orthopaedic surgery, neurotomies. For several years we have been using low energy shock waves to reduce persistent muscular contractures and to facilitate the rehabilitation treatment for correction of deformity and improvement of postural and motor functions.
Methods: During the last 4 years we have treated 44 patients affected by equinus deformity of the foot, 31 females and 13 males, with age between 2,5 and 16 years (medium age 6,7). 21 were affected by hemiparesis, 16 by diparesis and 7 by tetraparesis. All the patients were able to walk, 6 only with support. 5 patients have already received a surgical correction of the equinus deformity (Baker procedure), but the contracture was relapsed at a medium follow-up of 3,5 years. 2 patients underwent a surgical release of knee flexors. The protocol includes a cycle of 5 sessions, one per week. 1200-1500 shocks/sessions were applied at an energy level between 1.6 and 2.0 mJ/mm^2. The device used was the Minilith by Storz Medical. The rehabilitation treatment, based mainly on prolonged muscle stretching and executed immediately after each application and continued in the following days, allowed a persistent and optimal muscular relaxation. In 4 patients, in order to increase and stabilize the correction of deformity after E.S.W.T, we made 2 or 3 cast in gradual correction. 12 patients usually worn dynamic tutors type AFO and managed to restrict their use. However, after ESWT, the tutoration seemed to be more tolerable with an improvement of harmony and fluidity of the

walk during and after treatment. In only 5 patients, all aged over 10 years, we have associated to the ESWT an infiltrative therapy by means of botulinum toxin. All patients were studied at the time of recruitment in the study (T0), at the end of treatment (T1) and 3 months later (T3) with functional comprehensive clinical examination, including assessment of spasticity by means of a modified Ashworth scale, functional abilities and articular range of motion, integrated with baropodography and film recording. Some patients were also submitted at an examination of the walk executed with 5 tests of gait analysis according to the protocol of Davis, using an optoelectronic system with 6 cameras and a Kistler force platform.
Results: The patients included in the study showed in the pre-treatment phase a variable walking dysfunction characterized by an inconstant equinus deformity, persistent for the entire cycle and never completely correctable with passive manoeuvres. Shock wave therapy, applied in the manner following our protocol, has shown effectiveness in reducing focal spasticity and in countering the progression of miotendinous contractures and retractions. After the treatment all patients showed a significant reduction of equinus deformity supported by clinical manoeuvres and during the bearing, with significant increase of dorsiflexion, confirmed also by gait analysis, which at the evaluation of the dynamical parameters did detect a statistically significant increase of the peak plantar flexion moment during push phase and better function in the dynamics of the knee. Positive effects have also been checked concerning the symmetry of the hips and the pelvic tilt, with better stabilization of the centre of gravity and balance of the trunk. Even in these cases the mean and constant rehabilitation treatment accompanied the local treatment by optimizing the treatment results and keeping it for a long time (4-6 months). Repeating cycle therapy with shock waves is subject to the persistence of the result which is periodically reviewed at least every quarter.
Conclusion: Defocused shock waves represent the completion of the previously used method, which provided the “brushing” of the source on the muscle in order to extend the decontracturant effects of shock waves to a surface as broad as possible. With the new generator an enlarged beam is directly generated at the source in order to engage a surface treatment more widely, facilitating and extending the therapeutic application on the entire muscle mass. The results appear in the complex not only overlapping but definitely better because they allow to use slightly higher energies and to increase efficiently and uniformly the treated area, intensifying and making more long-lasting the decontracturant effects. Physiotherapy treatment is an essential corollary to any pharmacological or physical methods aimed at inhibiting spasticity and must be carried out with continuity, professionalism and diligence.
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51. Focused ESWT as a Useful Diagnostic Tool for Myofascial Trigger Points

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Device and producing company: Piezoson 100Plus, Richard Wolf

Introduction: Myofascial trigger points (MTrPs) are often found during a targeted examination of the shoulder. The question of how frequent and how important MTrPs are in the case of sports-related shoulder pain however, has not yet been clarified.

Methods: Sixty athletes suffering from shoulder pain were examined. In addition to sports-related anamnesis and clinical examination of the shoulder, palpation diagnosis for MTrP according to the diagnostic criteria established by Travell/Simons was carried out in the area of the entire shoulder musculature. On the basis of the rating of the pressure pain threshold, referred pain and recognition of the shoulder pain caused by the palpation, the importance of the diagnosed MTrP was evaluated. In addition to palpation, an examination of MTrP was performed with focused extracorporeal shock waves (fESWT) at a low energy level (max. 0.28 mJ/mm2) using a Richard Wolf Piezoson100Plus.

Results: MTrP-Palpation:
In the infraspinatus and biceps muscles of more than 80% of the shoulder pain patients, MTrP could be found by palpation. Also in most of the other shoulder muscles, numerous MTrPs could be found by palpation.
Palpation vs. fESWT:
Diagnostic criteria of recognition and referred pain in the infraspinatus and biceps muscle. Exemplary findings: Recognition and referred pain could be elicited by fESWT in a significantly higher number of athletes with shoulder pain than by manual palpation.

Discussion: Myofascial trigger points (MTrPs) can often be diagnosed when patients complain about sports-related shoulder pain, and they contribute considerably to the symptoms. Including the examination for MTrP will therefore broaden the understanding for the cause of shoulder pain.

Conclusion: Compared to palpation, the examination of MTrPs with fESWT elicited recognition and referred pain more often. For this reason fESWT can be considered a powerful diagnostic instrument for myofascial pain syndrome.

52. Treatment of Myofascial Trigger Points Using Focused ESWT

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Device and producing company: Piezoson 100 plus, Richard Wolf

Introduction: Myofascial trigger points are a frequent cause of performance-limiting shoulder pain in athletes. The study was designed to determine what improvements can be

achieved by an exact trigger point therapy using focused ESWT in active athletes suffering from acute or chronic shoulder pain with regard to their pain condition and force development.
Methods: A randomized, controlled, prospective study with n = 60 athletes suffering from shoulder pain (30 treated / 30 not treated, average age = 34.6 years) was conducted. The examinations were performed over a period of 6 weeks with four treatments (one treatment per week). As a therapy, piezo-electrically generated focused extracorporeal shock waves (fESWT) were applied to myofascial trigger points (MTrps) according to the principles of trigger point therapy using a Richard Wolf Piezoson 100 plus. The treatment was performed exclusively in the low-energy range (max. 0.28 mJ/mm^2) A sport-specific case history, clinical examination and evaluation of the pain symptoms were performed by means of a VAS score and the subjective rating by means of the Simple Shoulder Score (SSS). The isokinetic and isometric rates of force development were tested using a CYBEX Norm isokinetic test and training system.
Results: After direct trigger point treatment in 30 patients using fESWT a significant reduction in pain (p = .00) and a significant improvement in the SSS (p =.03) were found. Regarding isokinetic total work (Joule/Body Weight), a highly significant increase for external rotation (p = .00) was detected as well as a significant improvement of internal rotation (p = .04). Isokinetic measurements also yielded a significantly higher peak torque (Nm/Kg) for external rotation (p = .00) as well as a significantly higher peak torque for internal rotation (p = .03). In the control group no significant changes were found.
Conclusion: The treatment of myofascial trigger points using focused ESWT significantly improves the pain symptoms as well as the performance of athletes suffering from acute or chronic shoulder pain.

53. Shock Wave Therapy as an Alternative to Cardiac Cell Therapy – An In-Vitro Examination

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Device and producing company: DermaGold CP-155 (Tissue Regeneration Technologies, LLC, Woodstock, USA manufactured by MTS Europe GmbH, Konstanz, Germany)
Introduction: Recently it has been well documented that shock waves at low energy levels induce tissue regenerative effects. Transthoracic application of shock waves (SW) can be shown to augment myocardial vascularization in a porcine model of myocardial infarction. SW even improve myocardial perfusion and cause relief of angina symptoms in human patients with severe coronary artery disease. Nevertheless the underlying mechanism remains largely unknown.
Methods: Primary cell cultures of endothelial cells and fibroblasts were established from native rat hearts. Additionally H9C2-cardiomyocytes (American Type Culture Collection) were used. A thermostatically controlled water bath was designed to avoid distracting physical effects. Adherent cells in common cell culture flasks filled with culture medium were dunked into the water bath. Unfocused SW at an energy flux density of 0.15 mJ/mm2 were

applied to the cells with a frequency of 5 Hz. Non-treated cells were used as a control group. Number of cells and their vitality were analysed over a period of 7 days. Numerous analyses of immunohistochemistry and molecular biology were performed.
Results: SW stimulate every cardiac cell type to a different extent. Each cell type reacts at a different time point after treatment as well. The distance between the applicator and the cells and the energy flux density have a strong influence on the cells' behaviour. Between day 4 and day 5 the duplication time of treated cells was significantly higher compared to controls. Immunohistochemistry and molecular biology show significant differences in the gene expression of MMP's, TIMP's and collagen. Treated cells also alter their cytoskeleton (Vimentin, Tubulin, beta-Actin) and show significantly more proliferation (Ki-67) and changes in the expression of adhesion molecules (CD31) as well as connexins 40, 43, 45. No apoptosis was found in the treatment group.
Discussion: SW activate proliferation of cardiac cells. Endothelial cells proliferate fastest, which underlines the known effect of neovascularization in-vivo. Moreover, cells alter the assembly of microfilaments, and thus seem to ameliorate cell migration. Changes in the MMP and TIMP levels, as well as the expression of adhesion molecules seem to be strongly involved in the SW tissue regenerative effect on ischemic myocardium.

54. Further insights into possible mechanism of mechanotransduction

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Device and producing company: Piezowave, Richard Wolf, Knittlingen Germany
Introduction: Mechanotransduction is a mechanism by which cells convert mechanical stimuli into chemical activity via mechanorececptors and following signaltransduction.
Results: Reactive oxygen and nitrogen species, mesenchymal stem cells and heat shock proteins are involved in the mechanotransduction pathway.
Discussion: A possible mechanism will be discussed.
Conclusion: The correlation between the production of reactive oxygen species and heat shock proteins is under investigation.

55. Direct Epicardial Shock Wave Therapy in a Porcine Model of Myocardial Infarction – Pre-clinical Safety and Feasibility Aspects

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Device and producing company: CardioGold® CG050 (CRT Cardiac Regeneration Technologies, Woodstock, USA / manufactured by MTS-Europe)

Introduction: Animal trials with a rodent model of myocardial infarction showed promising results of direct epicardial shock wave therapy (DESWT). Cardiac function improved to a normal level however, safety and feasibility in a large animal model with hearts comparable to human hearts remain unknown.
Methods: Pigs were subdivided in 3 groups: unharmed myocardium with DESWT (healthy control, n=2), infarcted myocardium with DESWT (SWT-group, n=6) and infarcted myocardium without DESWT (control, n=2). Four weeks following myocardial infarction (MI), DESWT (300 impulses at 0.15 mJ/mm²) was applied directly to the infarcted area in the healthy control and the SWT-group; controls were left untreated. According to human cardiac surgery, some animals were treated with heparin prior to DESWT. Cardiac function was evaluated using echocardiography before MI, 4 weeks after MI and 4 weeks after DESWT. Electrocardiographic recording was performed during and after treatment.
Results: After DESWT, ejection fraction improved in the SWT-group as compared to 4 weeks after MI (62±9.1%, p=0.006); no improvement was observed in the control group (46±5%, p=0.126). As compared to healthy controls (69±1.4%) ejection fraction normalized in the SWT-group 4 weeks after SWT (p=0.358); it remained decreased in the control group (p=0.031). No arrhythmias were observed during treatment. In histological examinations no lesions of cardiac cells could be found.
Discussion: DESWT improves left ventricular function in a porcine model of myocardial infarction. No adverse effects, in particular no arrhythmias or cell lesions, were observed. Even in heparin treated animals DESWT showed no side-effects.
Conclusion: DESWT therefore seems to be an effective and safe therapeutic strategy for the treatment of ischemic heart disease.

56. Neoangiogenesis or Post-Natal Vasculogenesis induced by SW?

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Introduction: Over the last few years several reports have defined the existence of Endothelial Progenitor Cells (EPC's), which have an important role for neovascularization in ischemic tissues (1,2). Researchers in the field of Mesenchymal Stem Cells (MSC's) have suggested the presence of "bone marrow hematopoetic stem cell niches" (3), adding the concept of "circulating bone marrow hematopoetic stem cell"(4). Very recently, Da Silva Meirelles (5) presented an analysis of evidences that suggest "a perivascular location for MSC's, correlating these cells with pericytes" defining that "the perivascular zone is the MSC niche in vivo". On the other hand, accepted vascular mechanisms involved in tissue repair in adults were initially related to neangiogenesis and posteriorly to "post-natal vasculogenesis" (6,7,8), which infuse EPC's into sites of neovascularization and develop into endothelial cells (EC's). This process of "angio/vasculogenesis" appears to embrace recent discoveries and definitions derived from a stem cell´s field (9).
Discussion: Our histological results on shoulder rotator cuff tendinopathic biopsies [n:53 observations, 12 biopsies (non-SW group) and 13 biopsies (SW-treated, devices Dornier Compact Alpha , Orthospec, Storz Duolith SD1)] that received immunohistochemical procedures (monoclonal antibodies and techniques for PCNA, cd34+, cd14+, D2-40, Col I, Col III, Tenascin-C)] are:

Spontaneous reparative effects in shoulder tendinosis including 2 forms of responses: one is an open form, being the most common finding (diffuse focal angiogenesis with non-proper pericyte development and a propensity to micro-haemorrhagic foci); the second one is a "nodular form", much less frequent, in which we observed angio/vasculogenesis with proper pericyte development.
Analysis of cd34+/cd14+ behaviour (activity) in spontaneous repair indicates a moderate response for cd34+ and PCNA/Col I/Col III/Tenascin-C showed diffuse or scant activity, depending on the degree of damage.
Comparison with SW-treated tissue: we observed stronger cd34+ and cd14+ activity, developed mostly in "nodular form", with intense pericyte expression surrounding neo-vessels. Immunostaining for PCNA/Col I/Col III/Tenascin-C depicted higher activity, suggesting an anabolic condition for the node itself and for the original neighboring tissue, depending on migratory behaviour of a high number of cells PCNA(+) (focal hypercellularity).
Histological analysis in cases of SW therapy, demonstrated that neo-vascularised areas appears along the tendon structure, being able to distinguish different stages of neo-blood vessels maturity. Also the Tenascin-C marker showed progressive stages of vessels maturation.
D2-40 is a lymphatic marker that showed higher expression in SW treated tissues.
Conclusion: In summary, after SW therapy tendon tissue appears more vascularised and more cellular, indicating an improved repair capability. These findings suggests with high probability that both processes are involved after SW treatment.
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57. High Energy Shock Waves for Sonodynamic Therapy: Efficacy in a Syngeneic Model of Colon Cancer

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Institutions:
1.) Department of Clinical Pathophysiology, University of Torino, Torino, Italy
2.) Department of Anatomy, Pharmacology and Forensic Medicine, Univ. of Torino, Italy
3.) Med & Sport 2000 Srl, Torino, Italy
Device and producing company: Piezoson 100, Richard Wolf, Knittlingen, Germany

Introduction: The cytotoxic effect of the natural porphyrin precursor 5-aminolevulinic acid (ALA) exposed to high energy shock waves (HESW), generated by a piezoelectric device, was investigated in DHD/K12/TRb rat colon cancer cells in vitro and in vivo.
Methods: In vitro, cells were exposed to ALA (50 g/ml) for 24 h and then to HESW E1 (EFD = 0.22 mJ/mm^2, 1000 shots) or E2 (EFD =μ 0.88 mJ/mm^2, 500 shots). Viable cell growth was determined by trypan blue assay at day 1, 3 and 7 whereas cell death were investigated by flow cytometry with annexin-V-fluorescein and propidium iodide staining at day 1. In vivo, eight weeks after cell implantation in the caecum, syngeneic adult male BD-IX were treated with one i.v. injection of saline/ALA (375 mg/kg) into the tail vein 3 h before HESW E2 treatment alone or in combination with ALA. After 24 h in primary tumour tissues TUNEL in situ cell death detection assay was carried out and pro-apoptotic genes Bad and Bcl-2 mRNA expression was evaluated by quantitative SYBR Green real time RT-PCR. Moreover, as marker of activation of caspases during apoptosis, the cleavage of poly-ADP ribose polymerase (PARP) was investigated by western blot assay.
Results: ALA exposed to HESW resulted in a significant reduction of in vitro cancer cell proliferation at day 3 with respect to cells exposed to ALA (p.1 and 6.4 fold increase vs. ALA) or E2 (3.4 and 5.3 fold increase vs. ALA). In vivo, we observed Bad enhanced mRNA expression, Bcl-2 decreased mRNA expression ($p<0.05$) and enhanced apoptotic index (2.0 fold increase) in respect with ALA exposure. Moreover, after combined treatment with ALA and HESW, PARP cleavage was observed.
Discussion: In vitro findings show how the two schedules of HESW treatment investigated perform the same cytotoxic effects. In vivo, the E2 schedule treatment shows a significant enhancement of apoptosis in tumour tissues subject to the combined treatment with ALA. Therefore, the piezoelectric device is able in vivo to activate protoporphyrin IX after exogenous administration of ALA, with specific target of tumor cells.
Conclusion: ALA and HESW determine cytotoxic effects in rat colon cancer cells either in vitro or in vivo.

58. The Bactericidal Effects of Shock Wave Treatment for serious orthopaedic infections

Richard Coombs, M. Hafez, M. Petrou, M. Hanna, M. Munshi, V. Asopa, K. Periyasami, A. Hafez, J. Coombs

Institution:
Imperial College London, Charing Cross Hospital,
Dep. of Musculoskeletal Surgery, London, Great Britain
Device and producing company: Storz SLXF2
Introduction: Most deep orthopaedic infections can be treated by appropriate surgery. A small proportion of patients are unsuitable for surgical intervention. Deep infections in orthopaedic patients for whom surgery is inappropriate may be treated by shock wave treatment.
Results: We have experience of the treatment of deep infections in five clinical cases.
Discussion: The results of our treatment have been successful.
Conclusion: Our clinical experience of shock wave treatment for deep infection is anecdotal. It does suggest that this technique can have extremely helpful results. Our clinical experience has prompted experimental studies to confirm its general applicability.

59. The Use of Shock Wave Treatment for treating MRSA An experimental study

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Institution:
Imperial College London, Charing Cross Hospital,
Dep. of Musculoskeletal Surgery, London, Great Britain

Device and producing company: Storz SLXF2

Introduction: Our clinical experiences with shock wave treatment suggests that it may have a bactericidal effect against microorganisms. Sensitive Staphylococci can be treated with appropriate antibiotics. Multi-resistant Staphylococci can be challenging to manage and may only be sensitive to toxic agents

Methods: Controlled experiments have been carried out to assess the effects of shock wave energy against multi-resistant Staphylococcus aureus.

Results: Our studies have shown a statistically significant effect of shock wave energy on multi resistant Staphylococci.

Discussion: Our initial studies have been carried out with antibiotic sensitive Staphylococci. Our studies have now been extended to MRSA. It is perhaps not surprising that the shock wave energy has a similar effect, as the mode of action is not thought to be similar to the mode of action of antibiotics.

Conclusion: Shock wave treatment may offer a helpful addition to the management of MRSA.

60. The Fungicidal Effects of Shock Wave Treatment

Michael Petrou, R. Coombs, M. Hafez, M. Hanna, M. Munshi, V. Asopa, K. Periyasamy

Institution:
Imperial College London, Charing Cross Hospital, Dep. of Musculoskeletal Surgery and Dep. of Microbiology, London, Great Britain

Device: Storz Modulith SLX-F2 lithotripter

Introduction: The main microorganisms implicated in deep tissue, bone and prosthetic material infections in orthopaedic patients are bacteria, particularly the Staphylococci. Fungi that like humans are eukaryotic cells, such as C. albicans the Thrush Fungus are of paramount importance as they form biofilms at the site of infection thus preventing the activities of the immune system and antifungal drug. The aim of this study was to determine whether ESW at levels used to treat patients can kill C. albicans planctonic cells.

Methods: Four sets of duplicate experiments mimicking the conditions during infection were performed in which C. albicans cells were sandwiched in animal muscle in semisolid agar of similar viscosity to pus. The Candida cells were treated with ESW at various settings using the Storz Modulith SLX-F2 lithotripter. The viable counts were compared to those of untreated controls as well as controls that were not exposed to animal muscle.

Results: Exposure of Candida cells to animal muscle did not affect their viability. All settings resulted in cell death with 90% killing with 4000 ESW at 3Hz, EFD 6 and large focus. Treatment also caused a physical effect on the muscle at the interface of different viscosities.

Discussion: This study shows that ESW exert a significant killing on C albicans.
Conclusion: We believe that the physical effect seen on both sites of the muscle at the interface between low and high viscosity will play a crucial role in clearing infections by permitting antifungal drugs and above all the immune system to penetrate the site of infection.

61. In Vitro Effect of Extracorporeal Shock Wave Therapy on Atherosclerotic Arteries

Dan Zin

Institution:
Orthopedic Dpt., E. Wolfson Medical Center, Holon, Israel
Device and producing company: Cardiospec™, Medispec
Introduction: Extracorporeal Shock Wave (ESW) treatments have been successfully used to treat various pathologies for over 20 years, mostly in urinary lithotripsy and in Orthopedics. Because they induce neovascularization, SWs are used for non-healing wounds and ischemic myocardial tissue with excellent results. The purpose of this study was to evaluate whether any deleterious effect could be caused to coronary atherosclerotic plaque should shock waves strike it during ESW cardiac treatment with Medispec's Cardiospec™.
Methods: Under Ethical Committee approval and patients' informed consent, fourteen pairs of atherosclerotic arterial segments, originating from fresh below knee stumps were used and divided randomly to treatment or control groups. All segments were ≤ 5mm in diameter (for coronary artery simulation). The "Treatment" segments were placed in 0.9% NaCl water bath with one side wall open. The arterial segment was affixed at the focus of the shockwave of the Cardiospec™ device, which was dipped in the bath. Each "Treatment" segment was treated at energy levels and number of SW's that are several times higher than normal Cardiospec™ treatment parameters. All samples were histopathologically analyzed.
Results: There was no difference in the histological features seen in the treated group as compared to the control group in any segment.
Conclusion: ESW treatment with Medispec's Cardiospec™ is safe even in the case of deliberate focusing of SW's on coronary artery plaques at energy levels as well as number of SW's which are several times higher than normal treatment parameters.

62. Study protocol of vascular risk during ESWT

Emanuele Astarita, G. Romano, A. Cozzolino, G. Busco, A. Soldati, A. Tartarone, S. Russo

Institution:
Dep. of Surgery, Orthopedic and Traumatology, Microsurgery and Rehabilitation University Federico II, Naples, Italy
Introduction: Physicians who frequently work with shock waves when the affected area borders arterial and venous vessels of large calibre, often neglect to assess the integrity of those vessels. The assessment should be based on eko-fluximetric exploration of the morphological structure of blood vessels, associating morphostructural investigations. It is advised to take a careful medical history and to evaluate for signs of dismetabolic cardiac and cardiovascular diseases. Fortunately literature shows that the probability and risk of hemorrhagic accident and/or thromboembolism during the course of ESWT is very low.
Methods: The suggested protocol is based either on bibliographic review or clinical trials.

1) Draft and obtain signed Informed Consent.
2) Conduct careful anamnestic research of pre-existing pathological conditions and/or risk factors for vascular disease.
3) Stay apprised of cultural and technical updates, recognizing and applying "innovative technologies."
Results: The research conducted led to identification of local and general conditions of increased risk, as follows:
A) Presence of ateromatic and calcific, parietal and intraluminal plaque
B) Presence of endoluminal thrombus (whether arterial or venous)
C) Presence of neoplastic and/or degenerative stenosis of vessels
D) Presence of stenosis and/or vascular degeneration, particularly when present with liver disease, dismetabolic diseases, hypertension or use of estro-progestinic drugs
E) Tobacco, drug and/or alcohol abuse
F) "Age" of vascular structures involved
G) Gender
H) History of previous limb fracture complicated by thrombo-embolic accidents, or peripheral edema
I) Recent immobilization
L) Lifestyle with eating disorder (obesity, alcoholism) and/or use of tobacco and drugs
Conclusion: Based on the results obtained by adhering to the protocol, in terms of protection both for the operator and for the patient, we recommend the use of our protocol for practitioners of ESWT.

63. Side effects of extracorporeal shock waves

Ludger Gerdesmeyer, H. Gollwitzer, P. Diehl, L. Weil

Institution:
Mare Clinic, Kiel, Germany

Device and producing company: Various devices, all FDA approved
Introduction: Extracorporeal shock waves have been widely used for decades. Several randomised multi centre trials have shown efficacy but some without clinical relevance with regard to outcome criterion. Two FDA trials were re-analysed for adverse events.
Methods: A total of 504 patients were randomly assigned to receive extracorporeal shock wave therapy or identical placebo intervention. ESWT was indicated if they fit standard inclusion criteria. Within 3 sessions at 1 week intervals, 6000 shock waves were applied to treat chronic plantar heel pain. All treatments were performed without any local anaesthesia. Main time endpoint was defined as 12 weeks after final ESWT.
Results: Twelve weeks after last intervention several adverse events were documented. In the active group, 117 adverse events were documented as device related and 35 AE were scored as not device related after ESWT. If identical placebo ESWT were performed 19 relevant device related adverse events and 39 not device related AE occurred. No device related severe adverse events such as tendon rupture or neural pathological finding were reported.
Discussion: After standard ESWT of plantar heel pain adverse events occurred, some of which have shown clinical relevance. Although needed, no long term follow up was performed. Neither were systemic adverse events screened with regard to endocrine pathologies despite the fact that they occurred when ESWT was applied to kidney stones.

Conclusion: ESWT has shown to have a good efficacy/adverse events ratio but thorough knowledge of musculoskeletal disorders indicated for ESWT and treatment of ESWT-induced side effects is essential.

64. Effects of Unfocused Extracorporeal Shock Wave Therapy (ESWT) for the Healing of Distal Limb Wounds

Andressa Silveira, J. Koenig, L. Arroyo, A. Brooks

Institution:
Ontario Veterinary College, University of Guelph, Guelph, N1G 2W1, Canada
Device and producing company: DermaGold, TRT, LLC, Woodstock, GA
Introduction: Objective: To determine the effects of unfocused extracorporeal shock wave therapy (ESWT) on healing of distal limb wounds in horses.
Methods: Sample population: Six healthy mature horses (5 Standardbred and 1 Thoroughbred). Five 6.25cm^2 superficial wounds were created over both 3rd metacarpi of six horses. Forelimbs were randomly assigned to treatment (ESWT and bandage) or control (bandage only) groups. In the treated limb, each wound was treated with 625 shockwave pulses from an unfocused electro-hydraulic shockwave generator. In the control limb, each wound received sham therapy. Wound appearance was recorded weekly as either inflamed or healthy, and scored based on the amount of protruding granulation tissue. Standardized digital photographs were then taken to determine the area of neoepithelialization and absolute wound area. One biopsy was taken from one of the wounds on each limb every week for 6 weeks. The biopsy samples were used to evaluate epithelialization, fibroplasia, neovascularization and inflammation. Immunohistochemistry for alpha - smooth muscle actin was used to label myofibroblast.
Results: The gross evaluation of the wounds showed that control wounds were 1.9 times more likely to appear inflamed when compared with treated wounds. Control wounds had significantly higher scores for exuberant granulation tissue than the treatment wounds. Measurements obtained from digital pictures revealed that ESWT affected neither the size of the wound area nor the area of neoepithelialization. No significant difference was found for any of the histological or immunohistochemical parameters between the study groups.
Discussion: Although we found a macroscopic effect of ESWT on equine wounds, none of the histological parameters showed a significant treatment effect. It is possible that the low number of samples available for histological evaluation limited the strength of the analysis. We decided to perform only one biopsy per wound to avoid further changes in wound size, however a higher number of specimens would have allowed for greater statistical power.
Conclusion: In conclusion, in this study, treated wounds had less exuberant granulation formation and were less clinically inflamed than the control wounds, however, there was no difference on the overall healing time. Therefore, ESWT may be useful to prevent exuberant granulation tissue formation or treat chronic inflammation of equine distal limb wounds in horses, however further evaluation is necessary before recommendations can be made for its clinical application.

65. Shock Wave Therapy in Perineal Chronic Pressure Sore – Case Report

Paulo Roberto Rockett, M. Lui, F. C. Rockett

Institution:
Ortosom, Porto Alegre, Brazil

Device and producing company: Reflectron, HMT

Introduction: Studies suggest that ESWT is highly effective in treating patients with several types of skin lesions through antibacterial effects, promoting neovascularization and possible tissue regeneration. The aim of this study was to evaluate the results of applying ESWT to a perineal chronic skin lesion of a patient on whom both legs had been amputated.

Methods: Male patient, 26 years old, paraplegic since he was 15 years old when a bullet damaged his 12th thoracic vertebra. He had both legs amputated 7 years after the accident. A fall from a wheelchair caused a perineal wound which did not heal for about two years. Shock wave treatment was begun two years ago when the lesion size was 11.5 x 17.5 x 13 cm. Patient received seventy-two weekly sessions of ESWT with an electro-hydraulic device (Reflectron – HMT) using a special non-focused coupler. Treatment was performed on an outpatient base without anaesthesia. The number of impulses varied from 1631 to 5580 (100 to 1000 shocks/cm^2 at 0.1 mJ/mm^2, according to wound surface area).

Results: Clinical evaluation and photographic documentation showed that there was a gradual reduction in the size of the wound, secretions and use of medication.

Discussion: ESTW accelerated and improved repair of the non-healing wound.

Conclusion: Shock wave therapy proved to be feasible, safe and well tolerated by the patient in the treatment of chronic soft tissue wounds. Complementary studies will be required to evaluate the extension of this therapy on skin lesions.

66. Extracorporeal Shock Wave Therapy for Management of Chronic Ulcers in the Lower Extremities

Raoul Saggini, R. G. Bellomo, N. Scuderi, P. Fioramonti, A. Figus

Institution:
Dep. of Physical Medicine and Rehabilitation, University of Chieti "G. D'Annunzio, Italy

Device and producing company: HMT Italy

Introduction: Management of chronic ulcers in the lower extremities is still a challenge for patients and health providers. Recent studies showed extracorporeal shock waves (ESW) to be effective in stimulating growth factors, inducing angiogenesis and healing of fractures and injuries. This study was designed to investigate the possiblity of using ESW in the treatment of chronic wounds.

Methods: Thirty patients with chronic post-traumatic, venous and diabetic ulcers unresponsive to conservative or advanced dressing treatments were counselled about the use of ESWT as alternative treatment for their wounds. Thirty-two wounds were treated, 16 of which healed completely within six sessions of ESW.

Results: In all of the non-healed wounds, decrease in the amount of exudates, increase in the percentage of granulation tissue compared with fibrin/necrotic tissue, and decrease in wound size were statistically significant after four to six sessions of ESWT ($p = 0.01$).

Discussion: ESW therapy seems to be a safe, feasible and cost-effective treatment for chronic ulcers in the lower extremities.
Conclusion: Further research and clinical trials are necessary to evaluate dose and time intervals of sessions to standardize a protocol of treatment in the management of chronic wounds.

67. Summation of the Experiences Using Defocused ESWT for Chronic Skin Lesions in the Trauma Center Meidling

Rainer Mittermayr (1,2), Ch. Kölpl (1), M. Pusch (1), W. Schaden (1)

Institutions:
1.) AUVA Trauma Center Meidling, Vienna, Austria
2.) Ludwig Boltzmann Institute for Experimental and Clinical Traumatology – AUVA Research Center, Vienna, Austria
Austrian Cluster for Tissue Regeneration, Vienna, Austria

Device and producing company: Dermagold, Activitor, MTS/TRT
Introduction: Treating complicated soft tissue wound conditions (delayed/non-healing wounds) is extremely challenging but extracorporeal shock wave therapy seems to have great potential in this field. We present the annual, almost traditional, update from our clinical ESWT experience between 2004 and 2008.
Methods: Patient study enrollment was done during routine clinical work between August 2004 and December 2008. Patients of both sexes with soft tissue wounds of different etiology persistent longer than 1 month were included. The primary outcome measure was rate of wound closure. Secondarily, different correlation analyses (e.g. defect size, age, etiology) were performed.
Results: Through December 2008, 390 patients were treated with unfocused extracorporeal shock waves (male: 57%, female: 43%), primarily in an outpatient clinical setting. Mean age was 57.8±20.2 (2008: 50.4±18.0) in males and 61.6±19.2 (2008: 71.7±16.2) in females. As found in the analysis of 2008, the main wound location was the lower extremities (lower leg: 44.6%; foot: 13.9%) followed by the upper extremities. Patients who were treated due to wound healing disturbances (39.5%) and posttraumatic necrosis (31.3%) were most common, as they were last year, but percentages showed a slight increase over last year. In total 72% of the wounds treated with ESWT healed completely (2008: 69%). We were also able to see a slight decrease in non-respondent wounds (5.3% in 2009 vs. 5.9% in 2008). Fortunately, the percentage of patients who missed follow-up also decreased to 15.4% (23.7% in 2008). The mean of ESWT sessions was 2.9 times with a range from 1 to 15 sessions in total. The mean of total amount of applied pulses was 1,483 (range from 100 to 44,700). The healing time for wounds successfully treated with ESW was a mean of 43.8 days (±45). In recent analysis a correlation was found between greater wound size and non-healing wounds, as was found in 2008. Again, a correlation was also found between age and therapy responsiveness. The older the patient, the worse the prognosis of outcome with ESWT. First experiences (long term follow-up) with wounds which are healed in response to ESWT show smooth, good relocatable scars. In addition, in treating hypertrophic, algetic scars with shock waves we observed scar reduction concomitant with quality improvement and patient report of pain reduction.

Conclusion: ESWT shows consistently excellent results in treating sub-acute and chronic wounds which are partly non-responsive to standard care.

Lecture I

New trends in cardilage repair

Donato Rosa

Lecture II

Tendon pathology and sports

Andrea Ferretti

Lecture III

Treatment of Bone Loss and Non-Union with Circular Fixator

Alexander Kirienko, C. D'Agostino

Istituto Clinico Humanitas, via Manzoni 56, Rozzano , Milano 20090, Italy

Device and producing company: Ilizarov, Plustec
Introduction: The aim of this study was to investigate the outcomes of non-union and bone defects of long bones treated with circular frames using the Ilizarov method.
Methods: Forty-nine patients with 32 tibia, 8 femur, 2 humerus, 4 radius and 3 ulna non-unions were treated with the distraction method. There were 21 patients with bone defects (average 4.9 cm) and 27 patients with leg-length discrepancy (LLD) (average 3.5 cm). The number of previous surgeries was 1 to 8 (average 4). At the time of surgery, 17 (29%) non-unions were diagnosed as infected. All patients underwent repair of the non-union and application of Ilizarov frame. Patients with bone loss were additionally treated with lengthening techniques.
Results: Bony union was achieved after the initial treatment in 43 (87%) patients. The 4 persistent non-unions were re-treated with external fixator reapplication. This resulted in final bony union in 47 (96%) patients. The average LLD was 1.8 cm (0-4.6). Alignment with deformity less than 5 degrees was achieved in 43 patients and alignment with more than 6 degrees was achieved in 6 patients. Bone and functional outcomes were excellent or good in 43 patients.
Discussion: Ilizarov's segmental bone transport technique is a reliable option for the treatment of bone defects. The different technical difficulties and complications inherent in this method require the need for meticulous planning adapted to each surgical case.
Conclusion: The Ilizarov method is particularly useful in treating stiff hypertrophic non-unions, infected non-unions, bone loss, LLD, and poor soft-tissue coverage. Infected non-unions have a higher risk of failure than non-infected cases.

Lecture IV

Carpal scaphoid fractures

Umberto Passaretti, A. Penza, G. Lanni

ASLNA1 – Ospedale dei pellegrini, Via portamedina alla pignasecca, Naploi, Italy

Introduction: Carpal scaphoid fractures are very frequent in young people with strenuous working and/or sport activity.
Methods: The diagnosis of carpal scaphoid fracture is often delayed and treatment options are varied. Complications include delayed union or non-union resulting in pseudoarthrosis. Pseudoarthrosis treatment differs from acute fracture treatment.
Results: We use microinvasive surgical treatment by percutaneous access with excellent compliance and results. Sometimes we also use this treatment for pseudoarthrosis without bone necrosis.
Discussion: Although there is no commonly accepted treatment method for carpal scaphoid fractures, it is generally agreed that stabile, early and biomechanically correct synthesis produces good results.
Conclusion: We believe early treatment with microinvasive surgery produces the best results with the least complications.

Lecture V

In vivo shock wave therapy, biological effects on the miocardium

Stefania Montagnani

Lecture VI

May anti-inflammatory effect of ESW involve nitric oxide system?

Hisanori Suzuki

Names	Abstract Numbers
Aharinejad Seyedhossein	(55)
Akker Scheek van den I.	(30)
Alarcon Juan Maria	(45)
Alvarez Yarila	(10)
Amelio Ernesto	Roundtable Session 9
Aranzabal Jose Ramon	(22)
Arroyo L.	(64)
Asopa V.	(58 + 59 + 60)
Astarita Emanuele	(62)
Audain Roberto	(10)
Auersperg Vinzenz	Chairman Session 6 + (5)
Aydin Taner	(21 + 40)
Bahr A.	(54)
Bartak V.	(11)
Bassetto F.	(9)
Bellomo R. G.	(36 + 66)
Berta Laura	(57)
Berta Marina	(57)
Betancourt M.	(20 + 41)
Bloch Wilhelm	(6 + 8)
Bosco Vincenzo	(39)
Brañes Julian A.	(56)
Brañes Manuel	Chairman Session 2 + (56)
Brayman A.	(1)
Brooks A.	(64)
Buch Matthias	(5)
Buffolano M.	(48)
Busco G.	(25 + 62)
Buselli Paolo	Roundtable Session 9 + (14 + 38)
Buxbaum Frederick	(18)
Caione T.	(37)
Calemma A.	(25)
Canaparo Roberto	(57)
Cancelli F.	(36)
Capasso Myriam	(20 + 41)
Carillo M. R.	(23)
Carlota E.	(49)
Catalano Maria Graziella	(57)
Cavallaro C.	(23)
Chen H.	(1)
Chia Jason	(13)
Chirinos Raul	(10)
Citarella C.	(7)
Coco V.	(38)
Colella C.	(48)
Contreras H.	(56)
Coombs J.	(58 + 59)
Coombs Richard	Chairman Session 7 + (58 + 59 + 60)
Corrado B.	Roundtable Session 9 + (50)
Corrado Ezio Maria	President Session 1
Costa L.	(49)
Cozzolini A.	(62)
Crupnik Javier	(28)
d'Agostino Maria Cristina	Chairman Session 12 + Roundtable Session 9 + Lecture III
d'Ambra Raffaele	Chairman Session 6
De Durante Carlo	(48)

Delhasse Yvonne	(6 + 8)
Diehl P.	(63)
Dimonte D.	(7)
Donatelli Robert A.	(18)
dos Santos Paulo Roberto	(15 + 26 + 42)
Duchstein Hans-Jürgen	(54)
Dumfarth J.	(53 + 55)
Eid José	(46)
Epping H.	(51 + 52)
Fagnani Filippo	(2)
Ferretti Andrea	Chairman Session 7 + Lecture II + (27)
Fiaramonti P.	(66)
Figus A.	(66)
Foggia Luigi	(23)
Fornos A.	(49)
Frairia Roberto	(57)
Fraschini G. F.	(35)
Furia John Patrick	Chairman Session 3 + (33)
Ganey T.	(19)
Garofalo R.	(44)
Geng-Yan Xing	(34)
Gerdesmeyer Ludger	Chairman Session 4 + 10 + (5 + 63)
Gigliotti S.	Chairman Session 3
Gimeno F.	(49)
Gimigliano Raffaele	Chairman Session 4
Gleitz Markus	Seminar + (5)
Gollwittzer H.	(63)
Gonzalez F.	(20)
Gonzalez O.	(20)
Göschl R.	(55)
Gracia Nicolas Jose	(45)
Gries L.	(51 + 52)
Grimm M.	(53 + 55)
Guedez Miguel Angel	(20 + 41)
Hack F.	(53)
Hafez A.	(58 + 59)
Hafez Mustafa	(58 + 59 + 60)
Hanna Milad	(58 + 59 + 60)
Hellman Madleine	(18)
Hinz B.	(9)
Holfeld Johannes	Chairman Session 2
Holfeld Johannes	(53 + 55)
Iammarrone F. S.	(25 + 37 + 50)
Iammarronne Clemente S.	President Session 9 + (25 + 37 + 50)
Ibrahim Mahmoud	(18)
Imbrenda M.	(16)
Kapeller Barbara	(53)
Kertzman Paulo Facciolla	Roundtable Session 9 + (46)
Kirienko Alexander	President Session 8 + Lecture III
Kölpl Ch.	(67)
König Judith	(64)
Kuderna Heinz	Chairman Session 1
Lang Andreas	(24)
Lanni G.	Lecture IV
Leeuven van M.	(30)
Lolito Francesca	President Session 4 + Roundtable Session 9
Lombardi B.	(16)
Losert Udo	(53 + 55)
Lui Mara	(29 + 31 + 65)

Macca M.	(37)
Macfelda Karin	(53)
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Maier Markus	(5)
Mangiavini L.	(35)
Marlinghaus Ernst	(44)
Marx Sergej	Seminar
Matula Tom	(1)
Menge M.	(24)
Messina Sara	(14 + 38)
Minutulo L.	(27)
Mittermayr Rainer	(67)
Molinaro F.	(57)
Montagnani Stefania	President Session 2 + Lecture V
Moretti Biagio	Chairman Session 5 + (7 + 44)
Moretti Lorenzo	(7 + 44)
Morral Antonio	Roundtable Session 9 + (49)
Moya L.	(41)
Müller-Ehrenberg Hannes	(51 + 52)
Munshi M.	(58 + 59 + 60)
Nedelka Tomas	(11)
Neuland Helmut Garrelt	(5 + 6 + 8 + 24 + 54)
Neumann Kerstin	(54)
Notarnicola Angela	(7 + 44)
Novak Pavel	(3)
Ogden John	Chairman Session 5 + (19)
Oshiro T.	(11)
Ottone Maria Cristina	(2 + 17)
Passaretti Umberto	President Session 6 + Lecture IV
Patella Silvio	(44)
Patella Vittorio	(7 + 44)
Pellegrino A.	(48)
Penza A.	Lecture IV
Peretti G. M.	(35)
Periyasami K.	(58 + 59 + 60)
Petrosino A.	(23)
Petrou Michael	(58 + 59 + 60)
Pezzulo V.	(23)
Piergentili C.	Chairman Session 8
Pietramaggiori G.	(9)
Pittet B.	(9)
Pottebaum M.	(51 + 52)
Pusch M.	(67)
Quintero C.	(20 + 41)
Rädel Rolf F.	(5)
Raykov Dimitar Ivanov	(12)
Rockett F. C.	(65)
Rockett Paulo	(15 + 26 + 29 + 31 + 42 + 47 + 65)
Roldi E.	(17)
Romano G.	(62)
Rompe Jan-Dirk	(5 + 33)
Rosa Donato	President Session 3 + Lecture I
Rosenhek Raphael	(55)
Rudisch A.	(53)
Ruosi Carlo	President Session 7
Russo Luigi	(43)
Russo Sergio	President Session 12, Chairman Session 1 + 10 + (25+37+50+62)
Sadile Francesco	President Session 11
Saggini Raoul	Chairman Session 11 + (36 + 38 + 66)

Santos Lian Adolfo	(45)
Schaden Wolfgang	Chairman Session 8 + 12 + (5+19+53+55,66)
Schmidt Annette	(6)
Schultheiss Reiner	(19 + 55)
Scuderi N.	(66)
Serpe Loredana	(57)
Silveira Andressa	(64)
Soldati A.	(25 + 62)
Sosio C.	(35)
Souza Aná Claudia	(15 + 26 + 42 + 47)
Spaghetti I.	(16)
Stabler J.	(19)
Steiningen Caroline	(6)
Suzuki Hisanori	President Session 10 + Lecture VI
Tamma Roberto	(7)
Tartarone A.	(25,62)
Tedesco F.	(48)
Tepeköylü C.	(53)
Thiele Richard	Chairman Session 5 + 11 + (5 + 19)
Thomas Anita	(55)
Thorwesten L.	(51 + 52)
Tizzani Pietro	(57)
Tompetto C.	Roundtable Session 9
Trischetta D.	(27)
Troncati Franco	(16)
Utrera A.	(20 + 41)
Verratti Gabriele	(20 + 41)
Vetrano Mario	(27)
Vidal Xavier	(49)
Vigato Enrico	(9)
Villano P.	(23)
Vitali Matteo	(35)
Völker K.	(51 + 52)
Vulpiani M.C.	Roundtable Session 9 + (27)
Weil L.	(63)
Wess Othmar	(4)
Wille Georg	(5)
Yan Ruyun	(32)
Yildiz Yavuz	(21 + 40)
Yun-Huang L.	(34)
Zallone Alberta	(7)
Zimpfer Daniel	(53 + 55)
Zin Dan	(61)
Zwerver Johannes	(30)

Dear members of the ISMST:

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note to Catherine Auersperg, secretary of the ISMST Office: